Social Licence in the Marine Realm:

Improving Community Knowledge and Engagement

Rachel Kelly

Centre for Marine Socioecology,

Institute for Marine and Antarctic Studies

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Thesis declarations

Statement of originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any tertiary institution, and to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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Statement on ethical conduct

This thesis followed guidelines of ethical conduct in social science research. Ethics approval for component chapters of this thesis underwent ethical review, and received approval from the University of Tasmania Chair of the Tasmanian Social Sciences Human Research Ethics Committee (Chapter 5, HREC ref: H0016442; Chapter 6, HREC ref: H0017840), and the UFZ Datenschutz (Data Protection), Leipzig, Germany (Chapter 4; dated ref: 23/06/2017).

Signed:

Rachel Kelly

2nd August 2019

Abstract

Marine environments are complex and dynamic socioecological systems, where social perceptions of ocean stewardship are diverse, resource use is potentially unsustainable, and conservation efforts generally rely strongly on public support or acceptance. As a result, there is increasing consensus on the need to meaningfully include stakeholders and communities in marine planning and management. However, marine stakeholders and communities have diverse and disparate perceptions and relationships with the ocean, which further complicate the marine socioecological system and attempts to manage our interactions within it. Active and meaningful community engagement is central to fostering informed and socially accepted ocean management; thus, social science approaches are actively being applied and incorporated into marine management and research.

Social licence, a concept that reflects community views and expectations on the use and management of natural resources, is one such approach. Although social licence has been broadly applied across the terrestrial literature (e.g. oil and gas, forestry, mining, wind energy), its understanding and application within the marine sector has been limited to date. The overarching aim of this thesis is to improve current understanding of social licence in a marine context, and to identify how social licence can be created and improved for marine activities, industries and sustainable management into the future. Specifically, this thesis seeks to determine whether and how social licence can be used as an engagement tool to garner the community involvement necessary for supporting and advising managers of ocean resources around the world. The research components of this thesis are a first assessment of 'social licence in the marine realm', and conclude that social licence is an emergent concept in the marine sector, and that there may be great value in applying it to the marine context. Further, the research determines that social licence has largely focused on public perceptions of industrial and extractive uses of the marine environment, and identifies potential for exploring the concept in the context of community engagement and marine conservation.

Firstly, a need for social licence for marine conservation and for marine conservation science is outlined, calling for scientists to increase their awareness of, and engagement with, social and community needs and interests. Accordingly, new understanding is developed on how social licence might be used as a tool to support marine conservation and management, and to connect marine user groups. Multiple case-study investigations are conducted, primarily using qualitative socioecological approaches, including interviews, questionnaire surveys and Q-methodology, to explore stakeholder perceptions of the ocean and social licence, aiming to contribute to novel and improved understanding of social licence in a marine context. The case-studies capture insights from Australia

and Europe, and provide new understanding on social licence, as well as diverse perceptions of the marine environment, that are intended to be of interest to a global audience. This thesis is also the first to link citizen science theory with social licence, and identifies important linkages between social licence and citizen science that can work synergistically to support conservation; including engagement, connecting stakeholders, legitimacy and trust. Building upon these linkages, a framework towards achieving social licence for marine conservation through citizen science is created. Developing upon these insights further, the thesis research determines that marine citizen science can also connect marine user groups (i.e. fishers and divers) and improve their perceptions of one another. Thus, revealing how citizen science can provide opportunity for marine users to display their marine citizenship and improve perceptions of trustworthiness, which can lead to enhanced social licence for user groups.

Finally, this new knowledge of social licence is expanded beyond marine citizen science, and community perceptions and views on social licence for marine conservation (i.e. marine protected areas) are explored to create a framework for developing social licence that aims to guide marine managers, decision-makers, and stakeholders dealing with marine conflict and opposition in Australia and elsewhere. Future efforts to achieve ocean sustainability will greatly benefit from incorporating community perceptions and other social dimensions of the ocean. Social licence presents a tool and frame through which to examine and understand these perspectives. The concept of social licence is complex and intangible; this thesis does not attempt to simplify or contain it, rather it provides insight into how social licence might be achieved in practice.

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An buíochas is tábahachtaí ná do mo thuismitheoirí Noel agus Sharon. Thug sibh uchtach dom i gcónaí agus ní bheadh mé anseo inniu gan do grá and do thachaíocht. Tá an-súil agam go bhfuil sibh an-bhródúil asam.

The real challenge for today's conservationist is to learn to think like a human.

W. M. Adams (2007)

Statement of co-author contributions

Chapter 2 – *Social licence in the marine sector: A review of understanding and application*

- Rachel Kelly (PhD candidate) – 90%
- Dr. Aysha Fleming (supervisor; CSIRO) – 5%
- Prof. Gretta T. Pecl (primary supervisor; IMAS and CMS) – 5%

Chapter 3 – *Social licence for marine conservation science*

- Rachel Kelly (PhD candidate) – 85%
- Dr. Aysha Fleming (supervisor; CSIRO) – 10%
- Prof. Gretta T. Pecl (primary supervisor; IMAS and CMS) – 5%

Chapter 4 – *Social licence and citizen science: A tool for marine conservation*

- Rachel Kelly (PhD candidate) – 75%
- Dr. Aysha Fleming (supervisor; CSIRO) – 5%
- Prof. Aletta Bonn (iDiv and UFZ, Germany) – 10%
- Dr. Anett Richter (iDiv, Germany) – 5%
- Prof. Gretta T. Pecl (primary supervisor; IMAS and CMS) – 5%

Chapter 5 – *Citizen science and social licence: Improving perceptions and connecting marine user groups*

- Rachel Kelly (PhD candidate) – 80%
- Dr. Aysha Fleming (supervisor; CSIRO) – 10%
- Prof. Gretta T. Pecl (primary supervisor; IMAS and CMS) – 10%

Chapter 6 – *Social licence for marine protected areas (under review)*

- Rachel Kelly (PhD candidate) – 85%
- Dr. Aysha Fleming (supervisor; CSIRO) – 5%
- Mary Mackay (UTas and CMS) – 6%
- Dr. Carolina Garcia (UTas) – 2%
- Prof. Gretta T. Pecl (primary supervisor; IMAS and CMS) – 2%

Details of the co-authors' roles

Rachel Kelly developed the thesis objectives, thesis research design, data collection, data analysis and chapter/manuscript writing. Dr. Aysha Fleming and Prof. Gretta T. Pecl contributed to the project development and refinement, technical and conceptual discussions, and the development and refinement of each of the chapter manuscripts. Prof. Aletta Bonn provided guidance and support in the conceptual discussions, project design and data collection, and contributed to the analysis and manuscript writing of Chapter 5. Dr. Anett Richter contributed to the project design, data collection and analysis, and manuscript writing of Chapter 5. Mary Mackay contributed to the research design, data collection and analysis, and manuscript writing of Chapter 6. Dr. Carolina Garcia contributed to data collection in Chapter 6.

We the undersigned agree with the above state proportion of work undertaken for each of the above published (or submitted) peer-reviewed manuscripts contributing to this thesis:

Authors	**Author signatures**
Rachel Kelly	
Prof. Gretta T. Pecl	
Dr. Aysha Fleming	
Prof. Aletta Bonn	
Dr. Anett Richter	
Mary Mackay	
Dr. Carolina Garcia	

Signed: _____

Prof. Gretta T. Pecl

(Primary Supervisor)

2nd August 2019

Signed:_____

Prof. Caleb Gardner

(Centre Head, Fisheries & Aquaculture IMAS)

2nd August 2019

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Thesis Introduction

1.1 Background

Our global oceans are threatened by climate change (García Molinos et al. 2016;Pecl et al. 2017), overfishing (Rousseau et al. 2019), pollution (Villarrubia-Gómez et al. 2018;Vince and Hardesty 2019) and a growing list of other impacts that demonstrate an urgent and escalating global need for sustainable ocean management. As this need to sustainably manage and protect the ocean becomes more critical, decision-makers, managers and researchers are increasingly engaging in collaborative, socioecological interdisciplinary research (Stephenson et al. 2017;McDonald et al. 2018). Intrinsically, marine environments are complex and dynamic socioecological systems, where social perceptions of ocean stewardship are diverse, resource use is potentially unsustainable, and conservation efforts often rely strongly on public support or acceptance. Long-term sustainability can only be achieved where decision-making processes can recognise and incorporate these multiple and diverse values of the marine environment. This socioecological approach, encapsulating dynamic interests of both human and natural systems, is pertinent and necessary for the long-term management of our rapidly changing marine environments (Ban et al. 2013;Frusher et al. 2016).

Marine conservation initiatives have increased over recent years however, ocean management still lags behind the terrestrial sectors (Fraschetti et al. 2018;Watson et al. 2018), particularly in incorporating and involving communities in its development (Bennett 2018). These developments are largely hindered by complex and disparate regional marine management arrangements, diverse social values, and resource use conflict (Voyer et al. 2017). Unsurprisingly, relationships between diverse stakeholder groups and ocean spaces are a focal point of tension in marine planning and protection (Boucquey et al. 2016). Marine stakeholders and communities have diverse perceptions and relationships with the ocean and there is widespread consensus on the need to meaningfully include stakeholders and communities in marine planning and management (Brown et al. 2016). Yet, the majority of existing ocean management frameworks do not adequately address stakeholder interactions, concerns or conflict (Boucquey et al. 2016), and it is thus justifiable that community groups oppose efforts to improve marine sustainability in instances where their views, concerns and needs have not been included (Bennett 2018).

Challenges to including stakeholders in marine management have resulted in active calls for social science to be better incorporated in marine conservation (Mascia et al. 2003;Bennett et al. 2017b). This thesis contributes to this objective and explores marine stakeholder perceptions and engagement through the lens of social licence. The term and concept 'social licence to operate' is increasingly being applied to the marine sector in response to the recent and ongoing management challenges highlighted above. The concept reflects community views and expectations on the use of natural resources, and has arisen from a need to address challenges relating to social acceptability of, and community opposition to, natural resource use and management (Bocci et al. 2019). Social licence originated and is widely used in the terrestrial sectors (i.e. mining, oil and gas, forestry, wind energy) (Prno 2013;Moffat and Zhang 2014;Cooney 2017;Zhang et al. 2018) and this thesis proposes that much could be gained by applying and developing these insights in the marine context.

As of now, no consensus definition of social licence has been achieved (Boutilier 2014), nor does this thesis attempt to construct one. Instead, definitions used in the subsequent chapters are adopted from terrestrial sectors. These generally consider social licence an 'unwritten social contract' that indicates permission or support from communities and stakeholders for government, industry and/or science to use and manage natural resources (Hall et al. 2014;Boutilier and Thomson 2015;Moffat et al. 2015). As use of the term 'social licence' extends across different industries, activities and sectors, it is likely that understanding of the concept will change and evolve (Boutilier 2014) and in recent years, social licence has evolved for use in a conservation, as opposed to an industry, context (i.e. Voyer et al. 2015a;Kendal and Ford 2017;Garnett et al. 2018). In this instance, gaining social licence implies achieving and maintaining public trust that resource users and managers are utilising natural resources and spaces and resources in accordance with societal expectations.

Conservation often involves compromise (Dick et al. 2016) and from a conservation perspective, social licence presents a flexible means to demonstrate and leverage community influence on natural resource developments and protection (Garnett et al. 2018). Effective stakeholder engagement, cultural inclusion, conflict resolution and legitimate governance are all crucial components of sustainable marine management (Christie et al. 2017). Listening to, understanding, and respecting other stakeholders' priorities can facilitate more effective collaboration and more favourable management outcomes for all involved (Mason et al. 2016). The core components of social licence – engagement, meaningful dialogue, and developing relationships (Prno 2013;Hall and Jeanneret 2014;Boutilier and Thomson 2015) – can provide a means towards achieving effective and socially accepted marine management.

1.2 Thesis significance

Social licence cannot be clearly defined or outlined, and quantifying it is inherently difficult (Bursey and Whiting 2015). Still, much is to be gained by exploring how social licence can be attained (Moffat et al. 2015). This research explores current use of social licence in the marine realm and intends to determine how social licence can be developed. Although social licence is used broadly across the terrestrial literature, its understanding and application within the marine has been limited to date, and this thesis identifies where and how social licence may occur in the marine realm. Moreover, where social licence has been applied in the marine space, it has largely focused on public perceptions of industrial and extractive uses of the marine environment, and limited research has explored social licence for conservation. This thesis does not expand on social licence for marine industry or resource exploitation, rather it investigates how social licence can potentially be used as a tool to support marine conservation and management, and to connect marine user groups. Insights are gained through case-study investigations, and the chapters build upon one another in discussing and developing the theory of social licence, and exploring its practical application in a marine context.

Applied socioecological research provides insights, through investigations of place- and context-based case-study investigations, that can inform the wider context (Leenhardt et al. 2015). A socioecological perspective can also support the delivery of accountable and transparent decision-making. The qualitative investigations conducted as part of this thesis provide understanding on how communities and stakeholder groups might perceive the ocean and its myriad uses. Chapters 2 and 3 do not explore stakeholder perceptions, instead, they document the current literature and garner insights that are expanded upon in later chapters. The subsequent chapters largely adopt a constructionist approach, and build on one another to improve understanding on the theory of social licence in marine context, as well as develop insights that contribute to applying social licence in practice. This approach assumes that different individuals construct meaning on the same objects and/or phenomena in different ways, based on their diverse cultural, historical, and social perspectives (Moon and Blackman 2014). Multiple methodological approaches, including questionnaire surveys, qualitative semi-structured interviews, and Q methodology, are combined in the research chapters to more deeply explore stakeholder values and priorities. In doing so, this thesis aims to contribute to improved understanding of how inter- and transdisciplinary collaborations can be designed and implemented in a marine management context.

Conservation success is a pressing concern for marine management, and global interest is mounting in the application of experimental knowledge and towards more collaborative and participatory research and governance (Stephenson et al. 2016). Active and meaningful public engagement is thus necessary to foster this informed and publicly-accepted natural resource management. Global ocean literacy will need to be improved to i) promote engagement with communities and stakeholders, and ii) ensure that these stakeholders are adequately informed on marine issues to contribute to decision-making processes. Marine citizen science presents an important avenue to achieve such engagement, and this thesis is the first attempt to link social licence theory with citizen science. Building on current knowledge, and combining several methodological approaches, this thesis improves understanding of social licence and citizen science theories, as well as their application in sustainable ocean use and management.

Citizen science is often, but not always, a partnership between members of the public and professional scientists to address scientific questions and, often, issues of common concern, by collecting and analysing data, and publishing and communicating science via diverse outlets (Shirk and Bonney 2015). Comparably to social licence, citizen science can potentially provide a means for citizens and stakeholders to voice opinions, and to engage with decision-making that might otherwise exclude them (Cigliano et al. 2015). Citizen science programmes are rapidly gaining acceptance as an integral part of engagement between society, science and policy (Pecl et al. 2015;Hecker et al. 2018a), and this thesis suggests that marine citizen science presents a potential platform to engage with the public more actively, and develop relationships and dialogue that can increase understanding, acceptance and social licence for marine conservation. Community engagement has been established as key towards achieving social licence (Dare et al. 2014;Hall and Jeanneret 2014) and engagement that can be achieved through citizen science might facilitate communication and mutual understanding towards obtaining social licence.

Further, marine protected areas (MPAs) are promoted as a key tool for sustainable marine management (Edgar et al. 2014). The Convention for Biological Diversity set a global target to protect 10% of the ocean within MPAs by 2020 however, this target date has now been extended, owing to a global failure of implementing MPAs, and the fact that most large designated MPAs occur in off-shore areas that do not directly impact upon stakeholders. Community and stakeholder opposition to MPAs has been a substantial barrier to their implementation and success (Christie 2004), because MPAs require effective community engagement and social acceptability to achieve success (Voyer and Gladstone 2015). This thesis delves into the complex, and often contentious, topic of MPAs; aiming to

improve community participation and social licence for marine conservation through MPAs, with potential for these insights to be applied to regions where MPAs are currently socially unattainable.

1.3 Thesis objectives

The overarching aim of this thesis is to improve current understanding of social licence in a marine context, and to identify how social licence can be created and improved for marine activities, industries and sustainable management into the future. To achieve this aim, the research presented in this thesis seeks to achieve the following objectives:

I. Produce novel understanding of social licence, and identify whether it has potential to improve communication and engagement in sustainable ocean use and management;
II. Obtain qualitative insights into marine community perceptions of the sustainability and social licence of marine systems, including marine protected areas;
III. Identify how engagement, knowledge and perceptions of marine realm management might be improved, e.g. through an investigation of marine citizen science;
IV. Produce practical research outcomes that can be applied in sustainable ocean management, i.e. develop frameworks for achieving social licence in practice.

1.4 Thesis structure

This thesis provides a socioecological perspective on social licence in the marine sector. The chapters described below draw primarily on qualitative sociological methods, including literature review, content analysis, questionnaire surveys, semi-structured interviews and Q-methodology, to contribute to novel and improved understanding of social licence in a marine context. Further, the thesis is by compilation (i.e. by publication) and consists of seven chapters. As such, the core thesis chapters, 2-6 inclusive, have each been prepared in the style of a journal article. These chapters have been published (2,3,4,5), or are under review (6), in international peer-reviewed journals. Noting this, the individual chapter styles may vary as a result of the original journal formatting requirements, and some repetition will be observed, particularly in defining and contextualising the concept of social licence.

The separate research components outlined in the chapters below underwent ethical review and received ethical approval from the University of Tasmania (Chapter 5, HREC ref: H0016442; Chapter 6, HREC ref: H0017840), and the UFZ Datenschutz (Data Protection), Leipzig, Germany (Chapter 4;

dated ref: 23/06/2017). During each component of the research process (i.e. individual case-studies), care was taken to ensure that participants provided their full and informed consent to take part in the research. All questionnaire survey, interview and Q-methodology participants were provided with information outlining the details of the research. The interview and Q-methodology participants were also provided with a verbal overview of the research project, its purpose, the researchers' background and the risks associated with being involved, to ensure that their consent was informed. Importantly, the results of each study were provided to participants where possible, by means of infographics, oral presentations, and sharing the published articles with the stakeholders involved.

This first chapter is an introduction to the thesis that provides an outline of the structure of the presented research to follow. Subsequently, Chapter 2 is a literature review that sets the context of the research endeavour and identifies the theoretical foundations of this thesis. This review collates and synthesises instances of social licence in the marine realm as documented in the literature, aiming to provide understanding that may inform future research and development of social licence. The chapter reveals that social licence is an emergent concept in the marine sector, and that there may be great potential for its application in the marine context. Future themes and areas requiring investigation and application in this domain are also identified, to be developed in subsequent chapters.

Chapter 3 is an opinion article, written in response to the contemporary need for scientists, particularly marine conservation scientists, to engage with society to gain trust and social licence for their science and research. Decreasing trust in science in recent years has weakened social acceptance and approval for marine conservation and science. Working towards improving social licence may provide opportunity to bolster support for marine conservation, by allowing communities to engage with marine issues and marine science, and share concerns and opinions. Drawing from the literature, this chapter argues that marine conservation requires social licence and highlights science advocacy as a means to achieve this.

Chapters 4-6 are accounts of case-study research conducted with the aim of understanding marine space social licence under certain contexts, i.e. citizen science and marine protected areas. Chapter 4 explores whether and how citizen science can also play a role in generating social licence, using European marine citizen science as a case-study. In this chapter, in-depth qualitative interviews and a semi-quantitative online survey are used to investigate how citizen science can play a role in enhancing social licence and the mechanisms through which this can occur. This chapter highlights

important linkages between social licence and citizen science that can work synergistically to support conservation.

Chapter 5 develops upon this further, by investigating how citizen science may meaningfully include interests of diverse resource user groups, and whether it can promote exchange to potentially bolster social licence. This chapter explores a case-study of the Australian marine citizen science programme Redmap Australia, again via qualitative interview analysis and a semi-quantitative online survey, to understand community perceptions of other marine user groups; how they interact and how this relates to developing social licence. The results suggest that participation in citizen science improves perceptions of trustworthiness and can lead to enhanced social licence for user groups.

Chapter 6 build on the insights gained from the previous chapters. Social licence is applied as a frame to investigate support and opposition to marine protected areas. This chapter explores the perceptions of key marine stakeholders from Tasmania, Australia using a combination of Q-methodology and semi-structured interviews. This investigation reveals that social licence is not a support/oppose outcome and more nuanced understanding and dialogue around stakeholder engagement and perceptions of the ocean are required. These study outcomes are developed to create a framework for social licence and reveal novel insights for developing social licence in practice. The general discussion (chapter 7) summarises the theoretical and applied contributions of each of these chapters. This chapter concludes the thesis, and findings from the component chapters are placed in the context of each other and current literature findings. Recommendations for future research and application of marine space social licence are also presented.

Specifically, this thesis seeks to determine whether and how social licence can be used as an engagement tool to garner the community involvement necessary for advising managers of ocean resources around the world. The case-studies capture insights from Australia and Europe, thus providing new understanding on social licence, as well as diverse perceptions of the marine environment, that are intended to be of interest to a global audience. This thesis documents instances of social licence in a marine context, and the following chapters reveal how theory and application of the concept can be developed upon in improving marine management. It concludes by summarising the new knowledge produced and documented, and outlines recommendations for future application and development of social licence in the marine realm.

2

Social Licence in the Marine Sector: A Review of Understanding and Application

All of the research contained within this chapter has been published as:

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See Appendix G for the PDF of this published article. Note that here, the text and content of the paper remain intact but have been reformatted for the purpose of this thesis.

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Social licence in the marine sector: A review of understanding and application

Rachel Kelly[a,b,*], Gretta T. Pecl[a,b], Aysha Fleming[b,c]

[a] Institute for Marine & Antarctic Studies, Hobart, Tasmania 7001, Australia
[b] Centre for Marine Socioecology, University of Tasmania, Hobart, Tasmania 7005, Australia
[c] CSIRO, Salamanca, Hobart, Tasmania 7001, Australia

2.1 Introduction

Declining marine biodiversity and the increasing effects of human population growth and climate change on the oceans are gaining public attention worldwide (Frusher et al. 2016). As consumers become more affluent and communities more informed, expectation for sustainability and sustainable practices are fast becoming 'the norm' and communities are pushing for transparency and more involvement in decision making processes (Moffat et al. 2015;Colton et al. 2016). With increasing demand for natural resources, a concomitant positive trend towards engagement and partnership with users and citizens is emerging, and global discussion on citizen involvement in policy and decision-making processes is growing (Akhmouch and Clavreul 2016). Stakeholder involvement has been

demonstrated to improve the rigour and strength of decisions made, as well as the capacity of relationships amongst diverse parties, to promote successful outcomes for biodiversity (Young et al. 2013). Ocean management decision-making processes are complex, needing to address a wide range of concerns across multiple marine resources uses, as well as to adapt to a changing global climate. Trends are moving towards understanding and appreciating resource usage and perceptions from multiple perspectives (Ban et al. 2013) and active stakeholder participation in these processes is becoming widely accepted as necessary (Leith et al. 2013;Stephenson et al. 2016).

Social licence, as a concept, has not been universally defined but for clarity, this paper considers it 'an unwritten social contract' (Moffat et al. 2015) that reflects opinions and expectations of the broader community on the impacts and benefits of industry and government practices (Edwards and Lacey 2014). It is tacit permission that communities and society may grant for industry or government to utilise or control a resource (i.e. the marine environment, or components of it). Social licence occurs alongside other more formal legal requirements that may, or may not, explicitly require community involvement and consultation. Improved stakeholder engagement and empowerment help to promote learning and communication and generate holistic understanding of resource usage that are beneficial towards improving the capacity of ocean management in our changing world (Ogier et al. 2016) and the literature increasingly champions the role of community in decentralising management (Akhmouch and Clavreul 2016;Alexander et al. 2016). Further, conservation planners have an ethical responsibility to include local community voices in management decision making (Ban et al. 2013).

Worldwide, the cultural identities of local communities are intimately linked to their traditional values and uses of the marine environment (Agardy et al. 2003). Recognition of the significance of these cultures and social objectives in resource management is growing, with increasing focus on novel concepts including the 'social licence to fish' (Ogier et al. 2016) and there is great potential to explore how this may relate to cultural, social and individual 'rights to fish'. Nevertheless, there is limited guidance on how to advance this recognition towards actually incorporating social aspects of resource conservation into management and planning (Ban et al. 2013). Broad differences exist in perspectives of sustainability, that revolve around the interaction of resource use and exploitation with other ecosystem components (Hilborn et al. 2015). Social licence may play an important role in framing how stakeholder interests interact and how effective and collaborative management decisions can be achieved (Moffat et al. 2015). Incorporating 'bottom-up' approaches in management, and encouraging communication and engagement amongst community and industry, can allow for more opinions to be heard and more ocean conservation objectives to be addressed (Voyer et al. 2015a;Fox

et al. 2016). There may be great potential for dialogic approaches towards defining social licence, as well as developing criteria for awarding it, managing it and sustaining it (Parsons and Moffat 2014).

The purpose of this review is to assess how, and to what extent, social licence has been applied in the marine sector to date. It is likely that social licence, as a term, will continue to have currency given its widespread use but its evolution as a resource management tool will likely differ depending on industry, resource and project context (Hall et al. 2014). Further, social licence may be used interchangeably with the concept of 'corporate social responsibility' (CSR) in industry and academic literature, but whilst there is substantial interaction between the two, they remain two distinct concepts (Bice 2014). CSR, as a broader concept, addresses the social responsibilities that emerge from the corporate-stakeholder relationship and social licence is a component of this, providing a platform for the development of a 'stakeholder-centric extension' of CSR within industry (Hall and Jeanneret 2014). This paper's exploration focuses on applications of social licence in marine industries and management to identify future themes and areas requiring investigation and application in this realm. First however, social licence is defined from the terrestrial literature, exploring its origins, applications and development as a foundation for the later investigation of, and comparison to, the marine.

2.1.1 Social licence

Contemporary use of 'social licence to operate' first appeared in the mining industry as a metaphor, paralleling communities' influence and ability to stop mining projects with governmental ability to do the same (Boutilier et al. 2012). Since Jim Cooney (Placer Dome Inc. mining company, Canada) coined 'social licence' in 1997 (Boutilier 2014), it has become commonplace in the mining (Bursey and Whiting 2015), oil and gas (Yates and Horvath 2013), forestry (Edwards and Lacey 2014), paper-pulp mill (Gunningham et al. 2004), and wind power industries (Hall and Jeanneret 2014), amongst others (Boutilier 2014;Hall et al. 2014). This increasingly widespread use has allowed social licence to evolve from a metaphoric concept to a strategic management tool (Boutilier et al. 2012) that can be actively applied to planning and management in socio-political development.

Social *licence* suggests a governance role that perhaps proves misleading because there is not, necessarily, any formal process for attaining it (Bursey and Whiting 2015). Obtaining (and maintaining) social licence remains distinct (although often interrelated) from the formal licencing of permits and concessions by government and state bodies (KPMG-Australia 2013). Instead, social licence is an informal social contract between industry (and resource managers) and community that must be

earned and sustained on the basis of clearly demonstrated responsible performance as perceived by the community (Boutilier et al. 2012). Legal licences are tangible and issued by governing authorities for fixed timespans but social licence is typically intangible and impermanent and must be earned and actively maintained over time (Lacey et al. 2012). Regulatory approval or licencing of an activity to proceed does not necessarily indicate that it has social approval or licence (Edwards and Lacey 2014). Social licence raises many questions about who is defined as 'community'; what thresholds exist for support and endorsement; and which processes or metrics are involved.

Social licence has no formal basis in law (Yates and Horvath 2013), yet it is subtly tied to many legal processes towards gaining legal licence. Obtaining social licence does not guarantee a legal licence to operate, but it may still become regulatory in requiring certain types of behaviour and imposing sanctions (i.e. withdrawn support) on a company that fails to comply with the expectations and demands of stakeholder groups (Lynch-Wood and Williamson 2007). Companies may now require social licence in addition to their legal obligations (Parsons and Moffat 2014) and many licences require public consultation, as legal licencing alone has become increasingly insufficient in satisfying societal expectations. Whilst is has no legal force or standing, strong public opposition can directly affect the success of industry initiatives and industry recognise the need to obtain social licence to avoid potentially costly conflict with communities (Prno 2013). For these reasons, it is easier to identify where social licence has not been granted or has been withdrawn than where it exists, but positive indicators include, from (Yates and Horvath 2013):

- *'The reduction or absence of vocal opposition to development,*
- *Continued and increasing constructive participation in community and stakeholder dialogue,*
- *Advocacy and expression of support for development,*
- *Cooperation in community-based activities and enhancement measures, and*
- *Willingness of key stakeholders to enter into partnerships or other forms of agreement'.*

Social licence reflects the changing quality and strength of industry's engagement and relationship with communities of stakeholders (Hall et al. 2014). It indicates 'ongoing acceptance' of a company or industry's activities (Boutilier 2014), and has become a vital component of viable and sustainable resource use and development (KPMG-Australia 2013). Industry play a central role in the construction of social licence because they are both the party seeking it and the party with direct influence over how engagement and communication with community can proceed. Poor engagement processes and

negative reputations of community engagement may jeopardise the construction and maintenance of social licence (Hall and Jeanneret 2014). Social licence cannot be considered a short-term achievement nor a linear process. Its evolution from metaphor to management tool arises from the efforts of community and industry to define and measure it to produce a potentially valid and applicable instrument (Boutilier et al. 2012). Definitions and interpretations vary across industries and the literature but there is consensus that social licence has potentially at least as much influence as legal licencing (Boutilier 2014), as both legal and social 'licences' can make or break an industry. It creates a new dimension for resource management – acceptance that must be obtained from all stakeholders affected by an industry's activities or resource usage (Nelsen 2006).

Society is increasingly concerned as to how natural resources, including the marine environment, are utilised and developed and practices and uses that are not perceived as socially acceptable are unlikely to obtain social licence (Edwards and Lacey 2014). Some companies are adopting social licence as a component of their corporate responsibility strategy (CSR). Certainly, social licence can act as a means to realise the commitments made through CSR, which itself embodies certain principles and practices (Bice 2014), but to achieve such acceptance, or 'social licence' (Voyer et al. 2015a), industry will need to prioritise communication and the strength of their relationship with stakeholders (Hall and Jeanneret 2014). Different stakeholder and community groups identify and create different objectives and criteria for granting social licence and not all of these groups hold equal influence (Yates and Horvath 2013). Ergo social licence is earned through a combination of efforts and activities; lead by timely communication and meaningful dialogue, encouraging and demonstrating ethical and responsible behaviours that can contribute to building trusted and credible relationships between industry, managers and community (Yates and Horvath 2013). Since it origins, social licence has become less of a voluntary initiative and more a 'de facto prerequisite for development' and further, is a critical indicator of ongoing business viability (Leith et al. 2014a).

Environmental management of ocean and coastal systems is difficult (Leith et al. 2014b), with diverse opinions as to how resources and uses can be sustainably distributed. This review explores the discussion and application of social licence in this context, giving particular focus to marine protected areas (MPAs), aquaculture, and fishery industries. Recognition is growing that conservation initiatives such as MPAs can, and in many cases should, produce positive outcomes for both sustainability and development and the needs of the wider stakeholder community (i.e. resident communities, conservationists, fishers, government, tourists) (Bennett and Dearden 2014a), however marine management literature catalogues the contentious nature of these protected spaces (Suman et al.

1999). Historically, MPAs have been established to fulfil biological objectives but in sites where human dimensions have largely been ignored, 'biological success' may simultaneously result in social harm (i.e. conflict over resources and space, economical losses, etc.). This paper explores how understanding and accounting for the broader social benefits and impacts of MPAs may have potential to increase their social licence, success and long-term existence (Martin et al. 2016a).

A growing global focus on incorporating communities in management processes has seen the concept of sustainable fisheries include concern for the wider impacts of marine fisheries, including its ecosystem effects (Fulton et al. 2014). Still, fisheries and their management remain contentious issues in the public sphere. Increasing global demand for seafood has resulted in a rapid expansion of the aquaculture industry (Neori et al. 2007). Notwithstanding, communities of stakeholders are increasingly aware of the industry's environmental costs and impacts (Whitmarsh and Palmieri 2009), resulting in conflict that typically stems from community concerns about the negative social and environmental impacts of aquaculture farm sites. Here, examples of literature discourse are used to illustrate development, and instances of withdrawal, of social licence in marine aquaculture and fisheries and MPAs.

2.2 Methods

The objective of this review was to collate and synthesise instances of social licence in the marine realm as documented in the literature, explore its uses, and interpret its development in the marine context. The review sought to create a concise picture of its standing, understanding and application within ocean industries and the marine environment to better inform future development and research of social licence in the marine realm. Literature searches were conducted across three main databases: Scopus, Web of Science and ProQuest (Figure 1). All searches enquired for either:

'social licence' 'marine'*
'social licence' 'ocean'
*'social acceptability'** 'marine', or*
'social acceptability' 'ocean'

*Both 'licence' and the alternative spelling, 'license', were enquired for in the database searches.

**'Acceptability' was included because it is commonly considered the first step in achieving social licence (Boutilier et al. 2012), and is sometimes used synonymously with 'social licence' (Voyer et al. 2015a). Thus, this term was considered important in reviewing social licence in the relatively new context of marine systems.

Overlaps in papers between the three databases were counted only in the first database they were recorded. Abstracts of every publication yielded at this stage were read to ensure their eligibility and those outside of marine focus or English-language literature were discarded. The remaining papers (N=70) were read in full and the topic of each paper was documented (i.e. industry, management, etc.), along with its reference to 'social licence' and/or 'social acceptability'.

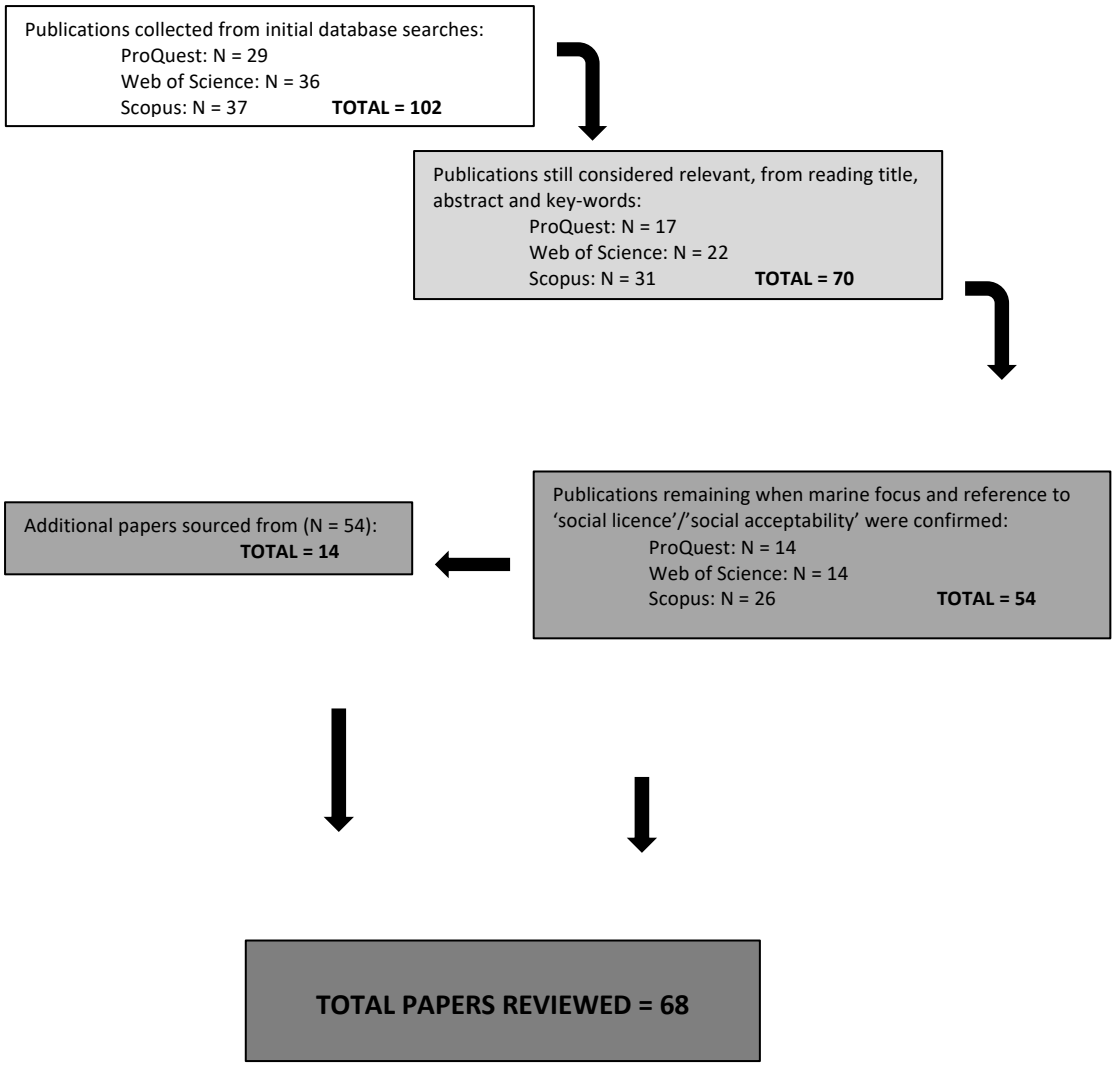

Figure 1. Schematic of the review process. Papers were collated from three main literature databases and the final set of review papers was obtained through this refinement process.

The references cited in eligible papers (N=54) were screened to be included in the final review. The same methodology was used, but criteria were extended to include 'public support' and 'opposition'. These papers had been sourced from articles confirmed to include 'social licence'/'acceptability' and were largely expected to discuss themes of social licence, even where they did not explicitly describe or define them. Further, 'support' has been used synonymously with 'social licence' to describe engagement between community and industry (i.e. Bursey and Whiting 2015). Once this systematic review was completed and a final set of articles were retained (N=68), the themes and criteria within papers were identified and recorded. The issues and themes discussed in this literature were further explored by supplementing from grey literature (e.g. ministry reports, industry documents, etc.), to better illustrate the concept of social licence in the broader marine context.

2.3 Results/discussion

Of the papers collated in this review, the oldest was written in 1999 (Suman et al. 1999) and the number of articles published since then has gradually increased over time (Figure 2), indicative of the growing interest in social licence in the marine sector. The term 'social licence' was referred to (in a marine context) in 11 out of N=68 papers (16.18%), and 'social acceptability' in 54 (79.41%). Other terms documented were 'support' (27.94%), 'acceptance' (17.65%) and 'opposition' (5.88%). It is not surprising that 'social acceptability' is more frequently discussed in the literature. As outlined earlier, it is considered the primary step to achieving social licence (Boutilier et al. 2012) and where documented, authors are more likely to discuss budding social licence initiatives or 'where it should occur' than examples of long-term, established social licence in marine industry.

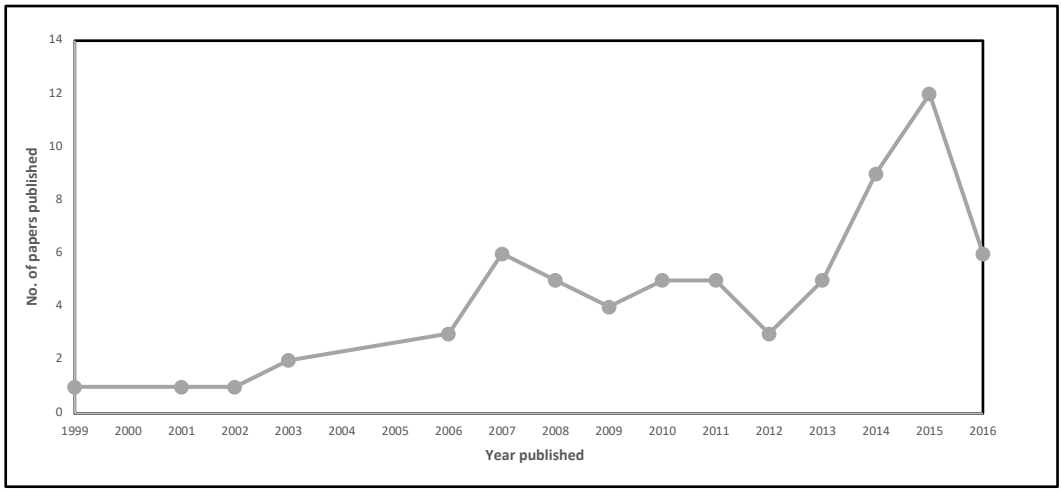

Figure 2. No. of published papers citing social licence in a marine context from the years 1999-2016.

Of the set of papers that explicitly referred to 'social licence', only five of the articles sourced from the databases offered any concise definition as to what it means or entails (Boughen et al. 2008;Mason et al. 2010;Kerr et al. 2014;Hobday et al. 2015;Richert et al. 2015), highlighting a gap in the literature in understanding how social licence could be defined in the marine realm (Table 1). Within these, they described social licence as an 'implicit contract' (Richert et al. 2015) that requires industries operating within local areas and communities to secure free, prior and informed consent from the community (Hobday et al. 2015), and emphasised that whilst it bears no legal standing, failure to obtain (and maintain) social licence from key stakeholder groups can have negative implications for marine industry (Mason et al. 2010). These follow in accord with definitions taken from the terrestrial literature (Nelsen 2006;Hall et al. 2014;Boutilier and Thomson 2015), bolstering the argument that knowledge and experiential data from these industries can likewise be applied to the marine realm.

Table 1. Papers collected that explicitly refer to 'social licence' in the marine context. The table outlines the nature and context of the literature obtained that explored social licence in the marine domain.

Author	Year	Definition	Industry	Conflict	Indigenous	Management/ Planning	Australian	International
Tollefson & Scott	2006		Aquaculture	I	I			I
Boughen et al.	2008	I	Seafloor exploration	I		I	I	I
Mason et al.	2010	I	Seafloor mining		I	I	I	
Rogers et al.	2014		Biodiversity offsets, Oil & gas		I	I	I	
Fulton et al.	2014		Fisheries			I	I	
Campbell et al.	2014		Marine littering				I	
Kerr et al.	2014	I	Marine renewable energy	I		I		I
Hobday et al.	2015	I	Conservation, Climate Change			I	I	
Richert et al.	2015	I	Conservation, Oil & gas	I		I	I	
Voyer et al.	2015		MPAs		I	I	I	
Voyer et al.	2015		MPAs	I	I	I	I	

Interestingly, social licence was also considered 'a tool' for marine industries to manage their socio-political interests by adhering to concerns and stipulations as imposed by communities and stakeholders. Moreover, it was suggested that this 'tool' could be used to encourage and foster public, private and civic sector cooperation towards sustainable development in marine systems (Richert et al. 2015). The value of social licence has certainly been documented in this literature and recognised as 'essential' to the future viability of many marine industries (Kerr et al. 2014). This is in consensus

with the grey literature, where it is suggested that fishers and fisheries will need to generate and sustain 'the rapidly emerging topic of social licence' (WRLC 2015) if they are to continue to access publicly owned ocean resources (FRDC-Australia 2015). The development of social licence in the marine realm will likely require coordinated effort at all levels of industry (Perez 2016).

Several themes dominated the content and focus of the total set of papers collated, the most common of which were marine management and conservation, aquaculture and fisheries. These three themes are explored in more detail below.

2.3.1 Marine management and conservation

Management was a predominate topic across the papers collated (89.71%) however, these also discussed a broad range of other themes and a variety of industries. Unsurprisingly 'Conservation' and 'Marine Protected Areas' (MPAs) were prominent topics under discussion within the literature (13 papers each respectively; combined, with overlap, 35.29%). This is reflective of growing recognition of the need for new approaches to marine management (Agardy et al. 2003;Agardy 2016;Jones et al. 2016;Scharin et al. 2016), engaging with, and incorporating local communities in associated decision-making processes (Bennett and Dearden 2014b). The literature affirms that similar to terrestrial experiences, social acceptance in the marine is dependent on the effectiveness and quality of management and government institutions as perceived by stakeholders (Bennett and Dearden 2014b), and that such management must focus on anticipating and reducing conflict (Thomassin et al. 2010). Social data may play a significant role in marine management, and decisions made without adequate consideration of socioecological components could risk undesirable social reactions (Kittinger et al. 2014).

Promoting social licence of and for MPAs is a key challenge globally (Voyer et al. 2015b), and the literature underlines how critical social acceptance is for successful MPAs (Adams et al. 2011). Improved engagement and community participation in conservation and governance schema may provide 'agents of change' to enhance conservation approaches and discourse (Cinner et al. 2016). However, whilst social acceptance is critical in determining MPA success, it remains a poorly explored area of research (Thomassin et al. 2010). Developing clear understanding of how different stakeholder groups utilise and value marine resources and spaces, including MPAs, is a logical step towards improving marine management practices (Christie 2004). MPAs do not only serve to provide protection for critical habitats and threatened species. They also function as important platforms for outreach and education on the socio-economic and ecological benefits of marine resource

conservation (Agardy et al. 2003). Identifying divergent perceptions between stakeholder groups will guide management towards understanding the issues and reasoning behind support and opposition (Thomassin et al. 2010) and ultimately, gaining social licence for MPAs.

Voyer et al. (2015a) demonstrated, by means of two Australian-based case studies, how local cultural, historical and demographic characteristics can play a significant role in how local stakeholder groups perceive MPAs and grant social licence. The paper's analysis and comparison between two protected sites illustrated the importance of 'recognising and encouraging diverse opinions and ideas' in achieving marine conservation objectives. Their results emphasised that neglecting to address communities' concerns and adapt management accordingly will likely exacerbate conflict and fuel opposition towards an MPA. Contrasting the management and stakeholder engagement conducted at each site, Voyer et al. showed that community trust in management and industry is 'crucial to obtaining social licence'.

2.3.2 Aquaculture

Global seafood supply and demand render marine aquaculture a permanent fixture on the marine environment. Attaining and retaining social licence is critical for sustainable development in the aquaculture industry (Barrington et al. 2010). Community perceptions and attitudes towards aquaculture are based on their awareness and knowledge about the natural resources and environments that industry are exploiting (Mazur and Curtis 2006). Undoubtedly, granting social licence in aquaculture will be founded on community perceptions of the industry's environmental record (Whitmarsh and Palmieri 2011). Past failure of aquaculture to acknowledge and appreciate the extent of stakeholder diversity may impede their ability to respond to public concerns and exacerbate mistrust in the industry (Mazur and Curtis 2006).

In their 2006 paper, Tollefson & Scott evidence how withdrawn social licence can also influence regulatory reform:

> *'Community input will play a significant role in determining whether an operator's resource consent will be renewed'.*

Their investigation compares two aquaculture industry evolutions, in New Zealand and British Columbia, Canada. The paper examines opposition to aquaculture as demonstrated by indigenous communities, but also provides good insight into local community dynamics and opinions more generally. It outlines the 'magnitude and furore' of debate and opposition to New Zealand's shellfish aquaculture that occurred in the early noughties as a result of rapid growth and the concurrent public

view that the industry was 'growing too quickly'. The article emphasises the interdependency between industry development and its need to recognise and address local community concerns and interests. Contrasting the New Zealand experience to a more juvenile Canadian industry, they highlight the necessity for industry to address the 'needs, interests and rights' of local communities to better inform decision-making that can generate the community support and licence upon which industry expansion will depend on. The paper exemplifies how an absence of strong social licence can fuel long-simmering debate and stagnate progress in marine industry, iterating this review's observations of a need to consider social engagement and licence from preliminary development stages.

The main objections to the establishment and development of aquaculture are its effect on marine ecosystems and surrounding environment (Katranidis et al. 2003), and its impact on community uses and cultural activities (Tollefson and Scott 2006). Poor engagement and knowledge-sharing on production processes, impacts, and product quality may lead to distrust and opposition amongst the wider stakeholder community (Bacher et al. 2013). Acknowledging and attempting to understand the diversity of perceptions within stakeholder groups can reduce misunderstandings and identify critical issues to be resolved to achieve socio-economic and environmental sustainability in aquaculture (Bacher et al. 2013).

Social acceptability can be promoted where socioeconomic benefits of the industry are clearly demonstrated and communities are well informed on the environmental impacts of aquaculture, as well as the regulatory and management processes that industry must comply with (Whitmarsh & Palmieri 2009). Likely, potential exists for social licence to be bolstered and improved within the aquaculture industry and its governmental regulation and policies (Whitmarsh and Palmieri 2009). It will need to recognise that communities can act as 'de facto regulator of the industry' (Gunningham et al. 2004), and work to achieve their consent, approval and social licence. Future work could investigate how communities perceive aquaculture and farm sites, how they regard possible and future development, and how these opinions and attitudes are constructed (Katranidis et al. 2003). Negative attitudes towards aquaculture, that can impede development of the sector, are often a result of poor knowledge about the industry and its activities. There may be great potential in applying discourse analysis to allow a diversity of interests to be articulated, and to identify conflicts between stakeholder groups, providing a starting point for negotiation processes in aquaculture industry (Freitas et al. 2007).

2.3.3 Fisheries

Of the nine fisheries-focused papers (13.24% total papers analysed) obtained in this review, only one explicitly referred to 'social licence' (Fulton et al. 2014), but this paper did not provide any definition of social licence or explanation about how it is conceived within marine fishery industries. Specifically, it explored the management of a complex multispecies fishery in South East Australia and determined that this fishery's 'social licence is low' due to poor ecological status and the impacts of lobbying on the setting of total allowable catches. A primary reason for management failure in fisheries is conflict between ecological requirements and social and economic priorities; frequently, the latter take priority in resource conservation. A dearth of reference to social licence in marine fisheries research suggests a need for more emphasis to be placed on socioecological interest, towards achieving desired sustainable fishery management outcomes. Management impacts are often culturally and context specific and may have poor success where social aspects have not been specifically addressed or integrated (McClanahan et al. 2009). Commercial fishers, for instance, may hold a very strong 'sense of place' or personal connection to areas that have special or unique characteristics that can foster personal attachment and belonging (van de Geer et al. 2013). Further, fisheries problems can influence larger socioecological problems, where fisher incomes often play a greater role than other fisheries problems in isolation (McClanahan et al. 2009). Local context and experiences will need to be identified and incorporated in management if fisheries are to obtain community support and social licence.

Resource users are likely to hold more positive perceptions towards fisheries when they have been actively involved in management decisions from the primary stages (McClanahan et al. 2009). In the absence of stakeholder forums, resource users may focus on selfish interests and authorities become isolated and inflexible. Participatory meetings that allow stakeholder groups to express and exchange opinions are a primary step towards integrating ecosystem sustainability requirements and the needs of resource users (McClanahan et al. 2009) and ultimately, generating social licence. Individual groups experience and potentially manage fluctuations in their own social licence, and legitimacy is developed and validated through tensions, negotiations and cooperation between these various groups and organisations (Leith et al. 2014b). For example, the arrival of the *Abel Tasman* supertrawler to Australian waters demonstrated the 'emerging role of social licence in decision making' (Haward et al. 2013). Reportedly the world's second largest fishing vessel, the proposed entry of the supertrawler into Australian pelagic fisheries raised considerable public dispute. Public opposition, voiced loudly by recreational and game fishers as well as environmental groups, led the Minister for Fisheries to revoke accreditation of the vessel, eventually resulting in its departure from Australian waters. This case

demonstrated that whilst social licence has no legal standing, legitimising processes may be abandoned in the face of perceived or actual dispute, or lack of social support or licence.

Australian-based research accounted for 25% of the literature collated in this review. Australian investigations into social factors affecting development in the marine realm are perhaps unsurprising when we consider that its beaches and ocean habitats are iconic and significant to the nation's culture, as well as its recreation and tourism industries (Mason et al. 2010). Further, Australia has one of the world's largest maritime jurisdictions, encompassing an area of approximately 14.5 million km^2, and 85% of the population live within 50km of its coastline. Social licence has been widely discussed in terrestrial industries in Australia (Boutilier et al. 2012;Black 2014;Moffat and Zhang 2014; etc.).

The term 'social licence' entered mainstream media not long after it was first coined in the US and has been documented in Australian media ever since (Lester 2016), and much investigation into its development and application has been achieved in business and terrestrial industry (i.e. Black and Bice 2016). Public conflict and opposition to forestry development on the island state of Tasmania, for example, has positioned it as a 'world leader in environmental conflict' (Lester 2016). Tasmanian society is considerably divided on issues of biodiversity conservation and commercial resource use (Kriwoken 2016). Community opposition to the state's forestry industry has had a global audience since the 1970's, when the United Tasmania Group (the word's first 'green' party) was established, yet it wasn't until 2010 that the industry publicly acknowledged social licence as central to securing its viability on the international market (Lester 2016). In 2014, Tasmania imposed a moratorium on the expansion of its state MPA system as a result of fisher pressure on governmental bodies (Kriwoken 2016). Australia's island state lags far behind its mainland counterparts in coastal and oceanic protection, its marine reserves totalling 2.67% of its water jurisdiction. Fishers are concerned about the effect of closed areas on fishing stocks and political support for Tasmanian MPAs is unlikely to be forthcoming in the near future. Local and community ability to influence political decision-making particularly through 'lobbying', as demonstrated in Tasmania, has set a precedent for developing social licence in natural resource management (Cullen-Knox 2014). Potential exists for an exploration of public perception and social licence dynamics in this marine space. Further, developing social licence understanding and the potential for its application as a tool on an international level is another pertinent area of investigation warranting address.

Assessing social licence after it has been granted or withdrawn is difficult, and attempting to assess it before it has been secured may prove even more problematic. Given its intrinsic nature, recognising

social licence 'in action' is difficult and it may be easy to assume its existence or conversely, difficult to prove its absence (Parsons and Moffat 2014). Still, attention to social issues are required if we are to identify factors that may hinder the progress of conservation initiatives (Hobday et al. 2015). Community diversity will need to be identified and explored if their opinions are to be heard and responded to by industries of marine renewable energy (Kerr et al. 2014). Overcoming community resistance is not the only facet to obtaining social licence for an MPA, or social licence more generally. Voyer et al. (2015a) highlighted the link between opposition to MPAs and the environmental knowledge of its communities of users but public perceptions are not always founded on technical knowledge and may even conflict with expert and scientific advice. It cannot be assumed that by providing more 'facts' and information, industry can garner greater stakeholder support (Kerr et al. 2014). Withheld social licence has potential to override legal licencing and prevent or delay developments and those influencing, permitting and responding to social licence should proceed transparently and ethically (Mason et al. 2010). However, social acceptability is likely to change over time, as society becomes more familiar and grows more comfortable with conservation measures and management outcomes (Hobday et al. 2015). Social licence is certainly dynamic and impermanent because opinions, beliefs and perceptions change and adapt as new information is acquired and assimilated.

2.4 Conclusion

This review recognises, and the literature affirms, that social licence is an emergent concept in the marine sector. Interpretations of social licence are many and varied (e.g. Nelsen 2006;Lacey et al. 2012;Boutilier 2014) and a coherent definition is lacking. Although 'social licence to operate' is increasingly being utilised in both the media and academic literature (Boutilier 2014), its meaning is often applied loosely, with no reflection as to how it actually affects societal realities or influences managerial decisions (Parsons and Moffat 2014). Boutilier (2014) advises that that the spread of the term 'social licence' across various sectors and industries is not accompanied by a consistent understanding of its connotations and implications.

As social licence becomes referenced more widely, the danger prevails that its meaning could become so blurred that it loses value as a tool for engaging communities and promoting collaboration. However, 'loose' meanings and concepts may allow for common ground to foster collaborative thinking and engagement, and may prove conducive to constructing social licence in the marine realm (Fleming and Howden 2016). Specificity can limit society's ability to move beyond definition and

respond appropriately to current and future scenarios (Fleming and Howden 2016), particularly in a space so diverse as the marine. The authors of this review embrace the fact that social licence cannot be clearly defined (Bursey and Whiting 2015) or easily quantified (Richert et al. 2015). It further adds to its appeal, if it can be used opportunistically and contextually, to serve the interests of industry, community and government (Gallois et al. 2016). Future work needs to determine the best means by which social licence can be developed.

Undisputed public resources do not exist. Socioecological approaches, encapsulating dynamic interests of both human and natural systems, are necessary for the long-term management of marine environments under our changing climate (Frusher et al. 2016). Such exchange is fundamentally underpinned by trust (Colton et al. 2016), another complex component of balancing relations between community, industry and government (Boschetti et al. 2016). Gaining social licence implies creating and maintaining public trust that industry and management are utilising marine environments and resources ethically, in accordance with community expectations (FRDC-Australia 2015). Discourse and engagement are integral to its developmental process (Rooney et al. 2014), and much can be gained by exploring how social licence is attained and applied in the marine realm.

To date, limited research has been conducted into the processes involved in obtaining social licence and the factors attributed to maintaining it (Moffat and Zhang 2014). Much could be achieved in exploring how, when and where social licence can be attained; for example, what thresholds exist for support and endorsement and which processes or metrics are involved. At this novel stage, social licence presents a promising means to develop dialogue between stakeholders involved in, or affected by, resource use and development (Moffat et al. 2015). It is not yet clear whether the concept of social licence relates in the same way to operational activities (i.e. industry, fisheries) as it does to non-operational activities such as conservation activities or MPAs, and this is certainly a gap in need of further research. The marine and coastal environment is a public resource and the public is its primary stakeholder. Exploring who its community of stakeholders are, how they withhold and communicate social licence, and how these marine stakeholder groups interact amongst themselves may have great potential to better inform decision-making processes, promoting more robust and complete outcomes for ocean conservation. The outcomes of this review suggest that by designing and implementing marine management that can appropriately and meaningfully accommodate social uses and interests, social licence may have potential as a tool to foster engagement and stewardship, promoting ocean conservation within local and broader-scale community groups.

3

Social Licence for Marine Conservation Science

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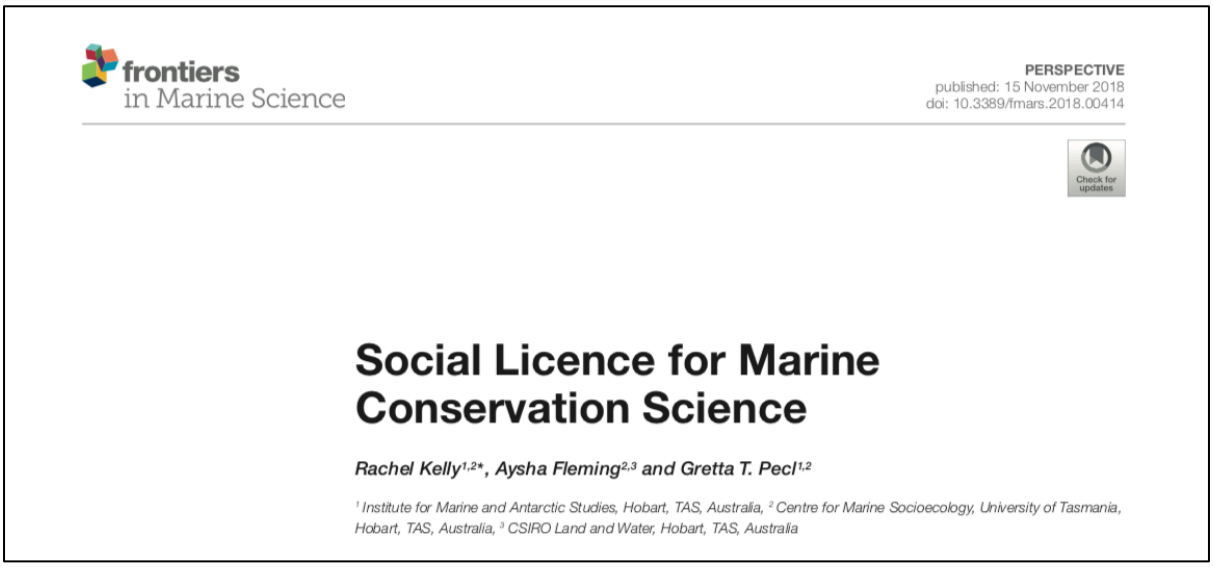
See Appendix G for the PDF of this published article. Note that here, the text and content of the paper remain intact but have been reformatted for the purpose of this thesis.



3.1 Introduction

Marine environments are complex and dynamic socioecological systems, where social perceptions of ocean stewardship are diverse, resource use is potentially unsustainable, and conservation efforts rely strongly on public support or acceptance. Globally, there is increasing awareness that society must be engaged in efforts to tackle marine conservation challenges. In parallel, there are increasing calls for scientists to engage more actively with society, to address publicly-identified issues and questions and to improve perceptions of legitimacy of marine conservation science (Lubchenco 2017). Trust always matters in the public sphere and whilst scientists may be regarded as 'competent', this does not infer that they are also considered trustworthy (Fiske and Dupree 2014). Issues around the public legitimacy of science are not necessarily based around public ignorance or understanding of science (Kellstedt et

al. 2008). Personal beliefs also shape public perceptions of science and are distinct from a poor, or lack of, understanding about science (Fiske and Dupree 2014).

Social licence is a concept that may be used as a tool to incentivise the public to voice concerns on marine issues that may otherwise remain unnoticed or ignored (Cullen-Knox et al. 2016). To date, no consensus definition of the concept has been achieved however, we, in this paper, consider it 'an unwritten social contract' (Moffat et al. 2015) that reflects broader community opinions and expectations on the impacts and benefits of industry and government practices, including research (Edwards and Lacey 2014). Social licence provides opportunity for ongoing engagement and two-way negotiation with the public and thus, reflects the 'changing strength and quality of acceptance and approval afforded by a community of stakeholders' (Hall et al. 2014). The concept is now considered essential for successfully establishing and running natural resource projects (Hall et al. 2014) and may have potential to foster engagement and stewardship in the marine space and for ocean conservation (Kelly et al. 2017).

Social licence is founded on meeting diverse and dynamic community (stakeholder) expectations, solid relationships and meaningful communication (Hall et al. 2014;Rooney et al. 2014). In exploring its use in marine conservation science, the need for social licence can necessitate the practice of effective scientific communication (Gallois et al. 2016), which can bolster outreach and advocacy efforts. Opening public discussion and providing more accessible scientific information can improve trust and strengthen relationships with society (Mason et al. 2016), and science advocacy is a means of public engagement that can improve public awareness of, and trust in, science. In this paper, we define science advocates as people who work for a scientific cause or group, and who engage in science outreach activities to inspire and teach about science (Carney 2014).

Whilst social licence for conservation has been discussed in the literature (i.e. Kendal and Ford 2017;Garnett et al. 2018), to date and to our knowledge, no literature has discussed a need for marine conservation scientists to 'earn' social licence. Certainly, decreasing trust in science has weakened social acceptance and social licence for marine conservation and science in recent years, and scientific priorities are often misaligned with marine stakeholder priorities (i.e. Mason et al. 2016). Within science culture, scientists' engagement with society is often viewed as an inferior pursuit to research (Martin 2017a). The prevalent 'publish or perish culture' commends academic accomplishment over public engagement when allocating tenure, and this is a structural limitation for scientists who

recognise the value of public science engagement, but who will receive no accreditation for their efforts.

Another hurdle for scientists willing to engage is that scientists are trained to communicate their research via 'the scientific method' (Green et al. 2018) and as a result, the readability of scientific papers is decreasing over time (Plavén-Sigray et al. 2017). Acknowledging uncertainty in research outputs is also a practice that is inherent to science, but which can diminish the perceived public legitimacy and authority of science (Zehr 2000). The communication of marine conservation science will inevitably involve uncertainty and marine scientists should be aware as to how this can potentially undermine public incentive to respond to threats and deterioration in the marine environment. Scientific uncertainty may engender public disengagement and the deference of any responsibility and urgency for action (Morton et al. 2010).

Marine conservation scientists should not assume that the 'public' (typically including coastal and fishing communities, indigenous groups, policy makers and others) share their world views and assumptions about marine environments and resources (Kohler and Brondizio 2017). Gaps are often apparent between the public's and marine scientists' perceptions of threats to the marine environment (Lotze et al. 2018). Societies' lack of trust in expertise of all kinds, including science and government, has heightened globally in recent years (Nichols 2017), with academics and their institutions regarded as ivory towers conducting research in isolated realms. Suppression and distrust in science is a global phenomenon and conservation science is increasingly seen as irrelevant (Parsons et al. 2015). Modern marine conservation challenges demand a 'hands-on' approach, whereby scientists can respond to public needs transparently (Lubchenco 2017).

The vast majority of marine science remains outside the public's direct experience and the public depend on other parties to inform and guide them in their interpretation of ocean science. Whilst science communicators have an invaluable role to play in science outreach (which we discuss below), scientists must also communicate their science to earn and maintain public trust. Third-party communication distances the public from science and may create distrust. Further, scientists risk their message being lost or miscommunicated by messengers who might not understand the true complexity of the science, or the importance of framing issues in context. Science outreach and advocacy, by marine conservation scientists, can engage communities in marine issues and improve their perceptions of marine science and conservation.

Science outreach, more generally, centres around building capacity, fostering trust and developing scientific understanding (Varner 2014). Science advocacy employs outreach, but focuses on ensuring that specific scientific outputs are shared with relevant people (i.e. a targeted 'public') in formats that are clearly understandable to them (Parsons 2013). Advocacy can be considered a more personal means of communication because scientists can voice personal elements of their work and research to form a connection with the public, and build trust through this relatedness and transparency. Science advocacy may provide a means to build rapport with society and elicit a connection, to earn legitimacy, support and thus, social licence for marine conservation science.

Science outreach and advocacy can also substantially impact upon scientists, who become more aware of public views relevant to their own science, and gain a variety of skills not formally taught in degree training (Beck et al. 2006). Further benefits may incentivise marine scientists to engage in outreach and advocacy activities. For example, the March for Science recognises this need for publicly-communicated science and has become an international 'force for science advocacy', that champions the role of science, to ensure its role and relevance in political decision-making. Scientific research remains largely publicly-funded and society expects that its investment in science will yield the best science available, to produce something useful (Lubchenco 1998). Outreach and advocacy are necessary to ensure that the public are informed about this best and useful science, and public engagement is increasingly an obligation for scientists. This is evidenced by funding schemes, such as the Australian Research Council's National Innovation and Science Agenda, which require supported researchers to engage with the end-users of their science.

Modern scrutiny of science requires scientists themselves to earn credibility. The ocean is often considered the 'next frontier' of conservation but activities in conservation increasingly require public support and social licence to be successful (Bennett 2018). Here, we argue that marine conservation requires social licence and that science advocacy (via outreach by marine conservation scientists) may provide a means to achieve this. We identify a role for science advocacy to enhance social licence for marine conservation research and highlight four key steps that can advise marine scientists to achieve and promote social licence for the research that informs and underpins marine conservation.

While not all scientists can, will, or need to engage in outreach and advocacy, marine conservation science in particular, as a field that is so germane to communities, needs to promote its research more clearly to the wider public. Developing respectful dialogue with society may allow marine conservation scientists to earn respect as a source of factual information and expertise. Passionate workers in their

respective fields, many conservation scientists are likely already advocates without realising it (Parsons 2016). Sharing this passion and advocacy with their wider community can enhance their credibility and promote social licence for marine conservation science. Below, we elucidate four steps for marine scientists to advocate their research, and build social licence for ocean research that underpins marine conservation.

3.2 Key steps

3.2.1 Engage with other disciplines: appreciate the value of social science

The need for social licence highlights the important role of human dimensions and public perceptions in conservation (Kendal and Ford 2017). A scientifically-engaged society can empower and incorporate the public in constructing democratic, scientifically-informed governance and decision-making, and this promotes social licence for science. The vast majority of marine conservation science occurs outside of the public sphere and the public depend on other parties to explain and guide their interpretation of marine science. We cannot expect that marine scientists and conservationists can expand their skills towards understanding public perceptions of science, and conducting science advocacy in response, on their own. Multidisciplinary discussions with social scientists, natural scientists, educators, psychologists, conservation marketing and others can connect diverse perceptions to enhance communication on marine conservation science and practice. Public perceptions research may be a valuable source of information to identify and understand society's diverse interpretations of marine science and conservation (Jefferson et al. 2015).

Interdisciplinary marine research is becoming more prevalent (i.e. Thébaud et al. 2017;Alexander et al. 2018). Marine protected areas research, as an example, has evolved from managing areas for biological conservation, to also incorporating social dimensions that promote sustainable resource protection adaptive to social and ecological needs (Agardy et al. 2003). Interdisciplinary marine research, similar to science advocacy, is not without its challenges (Alexander et al. 2018). However, interdisciplinary training (or at least, understanding) is a tool that allows a new generation of researchers to reconsider their research objectives, adopt new approaches that compliment other spheres of research and enhance socioecological outcomes that can promote social licence for marine conservation science. Early career researchers are increasingly educated and encouraged to conduct more applied research, to collaborate across disciplines and to engage with local communities. Certainly, the global conservation community is adopting more collaborative and integrated approaches for conservation (Bennett and Roth 2018) and there are increasing opportunities for

researchers to collaborate across disciplines and with society, including workshops, summer schools and conferences, such as International Marine Conservation Congress.

3.2.2 Understand that science has multiple audiences: there is no 'general' public

The public funding that supports most scientists infers a social responsibility to address public needs and to share science with society to maintain a 'social contract' or social licence for their research (Lubchenco 1998). Be it with policy-makers or the public, scientists should acknowledge that scientific language can have variable applications and consequences, dependent on communicator, audience, and context (Gallois et al. 2016;Drakou et al. 2017). Jargon and slang can produce wedges of misunderstanding, not only excluding stakeholders but also eroding trust between them (Mason et al. 2016).

Effective communication requires speaking in 'languages' that people understand, it is based heavily on trust and thus, scientists are required to communicate clearly and honestly (Cooke et al. 2017). Marine conservation scientists, perhaps more than other scientists, should to be willing to 'leave [our] comfort zone behind', to communicate across different languages, research in new circles and welcome other opinions (Mascia et al. 2003). Marine conservation scientists can create and adopt new languages and in some cases, let go of their familiar definitions and assumptions and work to accept ambiguity, if this can create positive engagement with science (Fleming and Howden 2016). For instance, improving the accessibility of scientific writing, to a range of audiences with different needs, can boost the impact of academic publications in a practical and applied sphere outside of the lab (Doubleday and Connell 2017).

Inaccessibility is an oft-cited reason for lack of trust in information, particularly digitally available information (Hart and Liu 2003). The online scientific newspaper 'The Conversation' is a platform which allows scientists (and others) to communicate their research in easily-understandable formats, as a freely-available resource. The paper's growing readership is indicative of the public legitimacy and trust it has achieved since its development. Marine conservation scientists, for example, can work to increase their relevance and legitimacy by sharing their science, via adapted research papers, with a broader public readership.

Marine conservation scientists should also be aware that online platforms continue to alter the means by which public information is accessed and opinions are formed. The internet has become the 'go-to' and preferred source of public information on science. Online users are observed to focus on

limited sets of websites and entrench themselves within distinct online communities, or 'clusters' (Schmidt et al. 2017). This promotes 'confirmation bias', the tendency for people to seek out and register information that confirms their worldview and ignore contradictory information, which can influence public perceptions of science (van der Linden et al. 2017). Meaningful, understandable and open scientific discussion with the public is necessary to maintain social licence than can evolve with society.

3.2.3 Improve scientific transparency: open science to the public

Science is founded on objective observation and description of the world around us and advocacy is tightly linked to subjective views and values on how that world should be. Yet, marine conservation scientists can engage in science outreach and advocacy without risking their scientific credibility or that of their scientific method (Kotcher et al. 2017). A large proportion of the public do want to know about science (Searle 2014) and scientists could share their research through means that are more publicly-accessible. Scientific communication that is fact-based, transparent and open can provide a tool for scientists to improve public understanding and appreciation of marine issues, without ever requiring persuasion.

'Proactive, persistent, clear and resonant messages are required' to promote trust in science (Gropp 2017) and there are myriad ways that scientists can open science to the public. For example, Massive Open Online Courses (MOOCs) are free, open-enrolment, web-based courses that are a resource for the public to learn about science directly from scientists. These courses provide a flexible way for the public to improve their own scientific knowledge, learning directly from experts from a wide range of scientific fields. MOOCs also facilitate scientists' ability to engage with large groups of interested public, often from the comfort of their own office. 'Skype A Scientist' (skypeascientist.com) is another initiative that links scientists to classrooms and students across the globe. Its aim is to link students to 'real scientists', to improve their understanding and appreciation of science and to interact with scientists. 'Let Science Speak' (letsciencespeak.com) is a similar online initiative that aims to 'humanize and amplify the voices of real scientists'. It provides public science information in various forms of media, including short videos, podcasts, editorials and social media, and aims to educate the public about current science and to foster support and social licence for scientists and their research.

Engaging the public in science can provide a means to achieve a more ocean literate society and enhance marine citizenship, stewardship and social licence for marine conservation (McKinley et al. 2017). Marine conservation scientists may also engage the services of professional science

communicators, to inform themselves on best available knowledge and practice for disseminating their research, and which can save time for pursuing their important research further (Illingworth 2017). Professional science communicators are qualified professionals who understand the need to address the context of particular marine science issues, and best means to connect these messages, to their public audiences. Whilst science is the focal message, the delivery and the messenger are also factors supporting the (un)successful uptake of information by any public audience.

3.2.4 Diversify public outreach: there are infinite ways to engage and communicate

Public platforms that encourage exchange of opinions and concerns (i.e. participatory meetings, citizen juries, MSC Certification for fisheries, opportunities for engagement with local government) are necessary to engage society and to promote social licence for marine conservation science. Science education in schools, which involves marine scientists in outreach and teaching, can also play an important role in enhancing ocean citizenship and literacy and public support for conservation science. Targeted events, such as 'science camps', considerably increase youth interest in marine science and champion science as an acceptable and viable career path (Kataržytė et al. 2017).

As highlighted above, the internet is the preferred source of public information on science, thus, it is a valuable media on which to engage and communicate with the public. The #OceanOptimism campaign is an example of active public engagement on marine conservation science issues which aims to demonstrate that not all ocean news is 'doom and gloom'. The movement shares positive information about successful marine conservation efforts, including an online 'monthly round-up' of positive ocean news. This collaborative movement has been hugely successful in communicating science to the public and to date, the hashtag has been seen by over 74 million internet users (oceanoptimism.org).

Informal outreach can also be effective. For example, Science in the Pub is an Australia-wide initiative that brings evidence-based research to an interested public, who 'weigh the evidence…with beer'. Citizen science is another rapidly expanding phenomenon that can influence research questions and provide the public with a voice in local environmental decision-making (Bonney et al. 2016). Recent developments in citizen science have bolstered projects' abilities to reach and inform wide audiences on important local, national and global issues, including marine debris, ocean plastics and climate change (Nursey-Bray et al. 2018) and actively engage the public in marine conservation science. Citizen science may be instrumental in 'breaking down the barriers' between science and the public (Vann-

Sander et al. 2016), improving science literacy, enhancing legitimacy of science (McKinley et al. 2017) and promoting its social licence.

3.3 Conclusion

The need for social licence for marine conservation, and the science that informs it, necessarily opens science to the public. Scientific impact is not only a function of economic and industrial interests and uses, but of social factors too. Marine conservation science should demonstrate itself legitimate, credible and trustworthy because positive public perceptions of science are required to ensure it is relevant and robust. Undoubtedly, the public hold some responsibility for informing themselves about science. However, we argue that scientists can engage and appeal to the public, by advocating for marine conservation science and highlighting issues and threats to the marine environment.

Given the 'wicked' complexity of most marine environmental problems and conservation challenges, adequate communication and cooperative effort between researchers from diverse disciplinary backgrounds is the way forward and time is of the essence. Marine conservation science needs social licence. Marine conservation scientists can engage and gain public support for their research and the conservation of marine spaces, systems and resources.

4

Social Licence and Citizen Science: A Tool for Marine Conservation

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See Appendix G for the PDF of this published article. Note that here, the text and content of the paper remain intact but have been reformatted for the purpose of this thesis.

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Research

Social license through citizen science: a tool for marine conservation

Rachel Kelly[1,2,3,4], *Aysha Fleming*[3,5], *Gretta T. Pecl*[3,4], *Anett Richter*[1,2] *and Aletta Bonn*[1,2,6]

4.1 Introduction

Public engagement through dialogue and participation in science is essential to improve knowledge about the environment and to support evidence-based decision-making for sustainable use of ecosystems and natural resources. Transparent and culturally-appropriate natural resource management is imperative (Christie et al. 2017) to foster sustainable environmental development. Society's role in decision-making is increasingly recognized (e.g. the Aarhus Convention 1998; IPBES 6, 2018) and the concept of social licence has become an important theme for development, particularly towards fostering stakeholder engagement and communication (Lacey et al. 2017). Understanding social acceptability of natural resource uses is crucial for environmental management (Gall and Rodwell 2016), and failure to consider whether social licence exists for conservation activities can result in the failure and contestation of initiatives and management decisions (Garnett et al. 2018). However, limited knowledge exists on how to obtain and maintain social licence through public

engagement, which we consider to include improving transparency and diversifying means of communication for community dialogue (Kelly et al. 2018).

Defined most simply, social licence is 'an unwritten social contract' from the public for government, industry or science to use and manage natural resources, including the marine environment (Moffat et al. 2015). Social licence suggests that society (i.e. communities and stakeholders) can award and withhold permission for an activity, and the term is increasingly used to describe implicit acceptance by communities for various uses of natural resources (Hall et al. 2014;Kendal and Ford 2017). Discussion around social licence is growing in the media and in different academic schools of literature, both in terrestrial and marine contexts (Boutilier 2014;Kelly et al. 2017), arguably in response to an increasingly (mis)informed society, and decreasing trust in politics and government (Smits et al. 2017) and natural resource management (van Putten et al. 2018a).

Whilst not directly associated with law, the concept of social licence owes its considerable power to the legal ramifications it can indirectly incur on resource users. It can be considered a precursor and decisive precondition to a legal licence (Garnett et al. 2018) and is a process that requires establishing meaningful partnerships between operations, communities and government based on mutual trust (Parsons and Moffat 2014). Social licence is theorised as ongoing acceptance or approval from stakeholder communities and public 'acceptance' is conceptualised as a minimum requirement for social licence (Boutilier et al. 2012). The term social licence has also been synonymised to 'free, prior and informed consent' (Yates and Horvath 2013), 'social acceptability' (Gall and Rodwell 2016) and 'social responsibility' (Edwards and Trafford 2016), amongst others. In this paper, we interpret 'social licence for marine conservation' as community acceptance or support of marine conservation activities and policies (e.g. in relation to species and/or habitat protection, marine resource usage, marine protected areas, etc.), and 'improving social licence' to mean increasing current public acceptance of these activities and policies.

Meaningful community engagement and dialogue is central to the development of social licence (Rooney et al. 2014). Social licence is dynamic, typically requiring time and effort to obtain and can be challenged or lost as community values and perceptions change over time. As such, it is frequently easier to identify where social licence is not granted than where it is (Yates and Horvath 2013). Further, the impermanent and intangible nature of social licence renders it difficult to measure (Hall et al. 2014) and to date, little research has explored mechanisms for obtaining social licence (Moffat and Zhang 2014). However, actions which have been linked to increasing likelihood of social licence include

meaningful dialogue with communities and demonstrated responsible behaviour with regards the use of natural resources (Yates and Horvath 2013). Furthermore, there is consensus that trust provides an essential foundation for social acceptance and social licence (Prno 2013;Boutilier 2014;Moffat and Zhang 2014;Bursey and Whiting 2015;Edwards and Trafford 2016).

As use of the term 'social licence' extends across different industries, activities and sectors, it is likely that understanding of the concept will change and evolve (Boutilier 2014). This ambiguity associated with the concept's metaphorical roots (Cooney 2017) adds to the appeal of social licence as an opportunity to improve understanding, if it can be used contextually (Prno 2013) and to serve the interests of all parties (Kelly et al. 2017). In recent years, the concept of social licence has evolved for use in a conservation, as opposed to an industry context (i.e. Voyer et al. 2015a;Kendal and Ford 2017;Garnett et al. 2018). In this instance, gaining social licence implies achieving and maintaining public trust that resource users and managers are utilising natural resources and spaces and resources ethically, in accordance with societal expectations. Communities are increasingly concerned as to how natural resources, including the marine environment, are used and developed and if such practices and uses are not perceived as socially acceptable, they are unlikely to obtain social licence (Edwards and Lacey 2014). Conservation involves compromise (Dick et al. 2016) and from a conservation perspective, social licence presents a flexible means to demonstrate and leverage community influence on natural resource developments and protection (Garnett et al. 2018).

It is increasingly evident that social licence is important for using, developing and protecting marine spaces (Kelly et al. 2017) but it remains unclear how social licence might best be achieved through public engagement in practice. Some research has been initiated on social licence for the 'Blue Economy' (Soma and Haggett 2015), and discussion around social licence for conservation is growing (i.e. Kendal and Ford 2017;Garnett et al. 2018); for example, marine conservation science has been highlighted as needing to earn and develop social licence (Kelly et al. 2018). Yet to date and to our knowledge no empirical research has been conducted into social licence for biodiversity conservation or specifically, marine conservation in Europe. This paper aims to determine whether citizen science is a novel means through which social licence can be developed to improve conservation success and sustainability in the marine environment.

Citizen science is often, but not always, a partnership between members of the public and professional scientists to address scientific questions and, often, issues of common concern (Shirk and Bonney 2015). Comparably to social licence, citizen science provides a means for citizens and stakeholders to

voice opinions, to engage in resource monitoring, to learn about science and scientific processes, and to evaluate and promote decision-making that might otherwise exclude them (Cigliano et al. 2015). Citizen science programmes are rapidly gaining acceptance as an integral part of engagement between society, science and policy (Pecl et al. 2015;Hecker et al. 2018a), and whilst developments have been made in recent years (Hecker et al. 2018b), understanding on the utility of citizen science in a marine policy and management context is limited.

Community engagement has been established as key towards achieving social licence (Dare et al. 2014;Hall and Jeanneret 2014) and in particular, the relationships developed through such engagement will facilitate communication and mutual understanding towards obtaining social licence (Yates and Horvath 2013). The literature documents many instances of community protest to marine conservation initiatives, including marine protected areas (Voyer et al. 2015a;Brennan 2018) and non-compliance in recreational fisheries (Bergseth and Roscher 2018) and a need for more open public engagement with marine conservation has been identified (Kelly et al. 2018). We suggest that marine citizen science presents a potential platform to engage with the public more actively, to establish relationships and dialogue which can connect them with science and policy, and can increase understanding, acceptance and support for marine conservation.

This study specifically focuses on the potential for marine citizen science to create a foundation for social licence for marine conservation, and investigates European marine citizen science as a case-study. The marine policy landscape is young and emergent within Europe, and the European Union (EU) promotes sustainable growth of maritime and coastal activities, as well as sustainable use of coastal and marine resources. However, whilst initiatives have been adopted to enhance the protection of the European marine environment (i.e. Marine Strategy Framework Directive in 2008; Marine Spatial Planning Directive in 2014) challenges to the effective implementation of European marine environmental management and legislation remain. A large component of these challenges include substantive criticism on 'inadequate stakeholder engagement' in EU policy making (see e.g., Soma and Haggett 2015). Impediments to new and planned developments include a lack of social acceptance, or social licence.

4.1.1 Linking social licence to citizen science

The link between citizen science and public support for conservation and science has been advocated in the literature, but has rarely been examined (Overdevest et al. 2004;Aceves-Bueno et al. 2015;Forrester et al. 2017). This paper is the first attempt to link social licence theory with citizen science, aiming to investigate the potential for marine citizen science to enhance social licence for marine conservation, and to produce practical outcomes that can be applied to sustainable ocean

management. In Table 2, we synthesise key related features of social licence and citizen science from the literature, and highlight common elements between the concept of social licence and the practice of citizen science.

Trust is identified as a central shared component in this analysis, and is also a major determinant of whether or not social licence is granted (Boutilier 2014;Moffat and Zhang 2014). Social licence is founded upon trust-based dialogue and relationships which require maintenance and development (Yates and Horvath 2013). Trust is closely tied to processes of public engagement (Hall and Jeanneret 2014;Moffat and Zhang 2014) and takes time, as parties begin to understand each other's expectations and engage in meaningful dialogue (Edwards and Trafford 2016). Ineffective engagement and relationship-building can produce distrust (Prno 2013) and resistance to future attempts to develop dialogue.

In our discussion of the outcomes of our study below, we highlight trust as a predictor of social licence. We explore marine citizen science coordinators' perceptions of marine citizen science and the concept of social licence, as well as the potential of marine citizen science to promote trust and enhance social licence for conservation. We build on the results of our survey and interviews to discuss how the two concepts influence knowledge exchange and development, and reflect on how citizen science can foster synergistic effects to improve engagement, ocean literacy, marine citizenship, trust and ultimately social licence for marine conservation in Europe.

Table 2. Synthesis of key elements common to social licence (SLO) and citizen science (CS).

*Note: Procedural fairness is a known component in achieving social licence (Moffat and Zhang 2014;Lacey et al. 2017), however, this is not a feature shared with citizen science and thus, we do not identify it here. Further, while we recognise that trust is complex and multifaceted, the different types, forms and components of trust are not explored separately here. We identify trust as an important component of social licence and citizen science more generally.

Social Licence (SLO)		Citizen Science (CS)
Communicating and constructing quality, two-way, meaningful dialogue with and between stakeholders is essential to generate SLO (Moffat and Zhang 2014;Zhang et al. 2018).	 **Engagement**	Maintaining volunteer participation in CS is required to build and develop project capacity (Bonney et al. 2009;Martin et al. 2016d;Nursey-Bray et al. 2018).
Earning SLO requires bringing stakeholders together to discuss, debate and define issues and improve community relations (Moffat and Zhang 2014;Lacey et al. 2017).	 **Connecting stakeholders**	CS brings diverse users together to share information and experiences, building relationships that might otherwise not exist (Aceves-Bueno et al. 2015;Bonney et al. 2016).
Addressing SLO issues, by facilitating dialogue, allows communities to raise concerns and opinions they might not otherwise have the opportunity to share (Edwards and Lacey 2014;Jijelava and Vanclay 2017).	 **Community Representation**	Collaborative development of CS between researchers and the public can identify issues and questions of community interest and enhance societal relevance of science (Thiel et al. 2014;Bonney et al. 2016).
Sharing perceptions, opinions and experiences can enlighten stakeholders, industry and government on the experiences of other groups (Gallois et al. 2016;Jijelava and Vanclay 2017).	 **Learning & Understanding**	Learning-by-doing in CS enhances understanding and scientific literacy (Bela et al. 2016;Turrini et al. 2018). Participants also gain greater awareness of threats to their examined ecosystem through direct experience (Bonney et al. 2009;Crall et al. 2012).
Earning SLO demands that parties demonstrate that their use of the ecosystem and data is credible, legitimate and trustworthy (Moffat and Zhang 2014;Gall and Rodwell 2016;Jijelava and Vanclay 2017).	 **Legitimacy**	CS promotes reflection and discussion on how science interacts with society and its values. Jointly developing projects legitimises data collection, production and application (Aceves-Bueno et al. 2015;Göbel et al. 2016;Elliott et al. 2017).
Communicating and debating groups' interests and concerns encourages dialogue and cooperation to achieve agreement and earn SLO (Gallois et al. 2016;Zhang et al. 2018).	 **Cooperation & Partnerships**	Working together in CS brings scientists and non-scientists together to develop and achieve joint research and educational objectives (Bonney et al. 2009;Nursey-Bray et al. 2018;Turrini et al. 2018).
Legitimising uses of the environment increases the trustworthiness of the		Promoting public engagement and involvement in collecting

decision-making it informs (Boutilier 2014;Jijelava and Vanclay 2017). Community trust is crucial for obtaining SLO (Voyer et al. 2015a). Trust is integral to all decision-making processes and is a central component of SLO (Dare et al. 2014;Moffat and Zhang 2014).	 **Trust***	evidence that informs management increases understanding and trust in these management interventions and by extension the people and institutions that make them (Aceves-Bueno et al. 2015;Hind-Ozan et al. 2017).
SLO gives a voice to communities, that they might act as overseers of their local environments and resources (Boutilier 2014;Cullen-Knox et al. 2017).	 **Stewardship**	Connecting the public to the natural environment through CS can increase awareness, attachment and willingness to protect it (Danielsen et al. 2010;Crall et al. 2012;Chen et al. 2015;Bonney et al. 2016;Newman et al. 2017).

4.2. Methods

We examined marine citizen science projects in Europe to investigate their potential role in promoting social licence. Building on this, we explored linkages between the concepts of social licence and citizen science. We used an adaptive theory approach in this study, akin to Vann-Sander et al. (2016). In comparing and contrasting the concepts of social licence and citizen science, it was anticipated that new theory would be generated and it was thus necessary to ensure that all relevant information on the topic was captured effectively as it emerged through the research process.

To achieve this thorough examination, we chose to combine in-depth qualitative interviews with an online semi-quantitative survey of marine citizen science managers. We adopted this mixed-methods approach to engage as deeply and actively with participants as possible, to understand their perceptions of marine citizen science and its connection to social licence occurring in practice. This mixed-method approach ensured a complete assessment of citizen science coordinators' views on the value and potential of citizen science as a tool to enhance social licence for marine conservation. Human ethics approval for this research was authorised by UFZ Datenschutz (Data Protection), Leipzig, Germany (23/06/2017)

4.2.1 Surveys

The initial research phase consisted of an online survey of marine citizen science project coordinators which aimed to obtain information on the extent of projects in Europe and their objectives (i.e. education, data collection), as well as coordinators' perceptions of European marine management and

conservation. This sample of projects was obtained from the European Marine Board's report on marine citizen science (Garcia-Soto et al. 2017) and was further supplemented by sharing the survey online amongst colleagues in wider networks to disseminate it to other potential respondents. Of the initial (n=60) project coordinators approached, 34 (56.67%) coordinators responded to the online survey (conducted using Lime Survey GmbH). The survey data was analysed in Excel (for Mac 2016). The list of survey questions is provided in Appendix B.

4.2.2 Interviews

Following the survey, potential interviewees were identified from the survey respondents. All respondents were invited to partake in the interview stage and 15 agreed to do so. These semi-structured interviews were conducted by the lead author in July, August and September 2017. The interviews lasted between 30-80 minutes, were conducted over the phone and audio recorded before being transcribed by the lead author. To ensure the anonymity of all participant responses, all interviewee names were replaced with identity codes (as used in the quotations below). The interview questions focused on the organisation of citizen science, project objectives, their development and their potential connection to social licence. Interviewees were also asked questions around their understanding and awareness of the concept of social licence, both in a general sense and in a marine context. The list of interview questions is also provided in Appendix B.

All interview transcripts were subject to thematic analytical evaluation using NVIVO (QSR International 11.4.3 2011). Initial codes were generated and themes were developed iteratively using a grounded theory approach (Haywood 2015). These were reviewed, compared and redefined where required to identify relationships between codes. Hierarchical coding was used to organise the transcripts into themes and thus, produced the resulting six key themes of the study. These themes are presented below and represent the synthesised responses from the interviews, as opposed to the questions that acquired them.

4.3 Analysis of themes

The online survey responses represent 34 projects of varied sizes and purposes from more than eight different European countries, the majority of which are located in the U.K. (19 projects or 55.8%). The coordinators' responses represent a diversity of projects, and the surveyed projects vary considerably in size, scope and intent. We note that project design influences project potential to collect and share scientific information and to engage with the public (Shirk et al. 2012). Consistent with other studies on citizen science, the projects described here generally do not formally document and report on any

participant learning objectives or achievements (Bela et al. 2016) hence, the interview phase assessed these elements of citizen science.

The 15 interviewed projects (Table 3) were largely representative in type and in opinion, of the 34 projects sampled in the online survey (Appendix C). Both the oldest (1970's) and newest projects (2017) were included in the interview phase. The diversity of countries who responded to the survey were also mostly represented in the interviews. We note, however that not all European marine countries are represented in our study and deduce that this may be a result of: i) marine citizen science not necessarily occurring in some countries, and ii) the English language barrier. Future European studies could focus, for instance, on the Mediterranean or Baltic Sea Regions and include the diversity of languages that would be required. All coordinators of all projects surveyed and interviewed in this study observed that marine citizen science could work to influence marine policy and management in Europe. However, we highlight that the results presented here represent the views and responses of coordinators only and as such, cannot be considered representative of the marine citizen science community as a whole.

The interview coding (i.e. analysis of qualitative data) produced six key themes: *developing understanding, communicating, project logistics, advancing citizen science, people and partnerships,* and *connecting*. *Developing understanding* was the most commonly identified theme (147 references across all 15 sources) and *connecting* was the least mentioned (with 76 references across all 15 sources). Below, we elucidate these six themes and refer to existing literature to identify their interplay and roles in citizen science and social licence.

Table 3. Overview of the 15 marine citizen science projects that engaged in interviews. These projects represented six countries, had varying levels of establishment (i.e. long-established, ranging to very new projects), different objectives in regards to marine research and conservation, and were supported by different schemes.

	Project Name	**Country**	**URL**	**Establ-ished**	**Marine focus**	**Funding**
1	BeachExplorer	Germany	https://www.beachexplorer.org/	2012	Intertidal	Federal ministry
2	Big Seaweed Search	U.K.	www.nhm.ac.uk/seaweeds	2009	Seaweeds	Lottery-funded
3	Capturing Our Coasts Bangor	Wales	https://www.capturingourcoast.co.uk/partner/bangor-university	2015	Intertidal	Lottery-funded

4	Capturing Our Coasts Newcastle	England	http://www.ncl.ac.uk/nes/outreach/marine/projects/capturingourcoast/	2015	Intertidal	Lottery-funded
5	Dive Into Science	U.K.	http:// http://www.diveintoscience.org/	2008	Marine environment	None
6	My Ocean Sampling Day	Germany (Global)	http://www.my-osd.org/	2014	Plankton (Aquatic bacteria)	Institute, Federal ministry, EU funding
7	One Ocean Forum	Italy (and wider Med)	https://www.oneoceanforum.org/en/	2017	Marine environment	Rolex, Audi, etc. (Link)
8	Open Litter Map	Ireland	https://openlittermap.com	2017	Marine litter	Participant donations
9	ORCA	U.K.	http://www.orcaweb.org.uk	1995	Marine mammals	ORCA charity
10	Seasearch	U.K.	http://www.seasearch.org.uk/	1970's	Marine environment	National conservation bodies
11	Secchi Disk Study	U.K.	http://www.secchidisk.org/	2012	Marine environment	The Secchi Disk Foundation (Link)
12	Spot the Jellyfish (Spot the Alienfish)	Malta (and wider Med)	http://oceania.research.um.edu.mt/jellyfish/	2010 (2017)	Jellyfish	International Ocean Institute, Malta Tourism Authority
13	Studland Tagging Project	England	http://www.theseahorsetrust.org/	1999	Seahorses	Sponsorship, donations
14	The Big Jellyfish Hunt	Ireland	https://www.facebook.com/ecojel/	2008	Jellyfish	EU INTERREG IVA (2008-2012); No funding (2013-)
15	Waves of Waste	U.K.	http://www.ywt.org.uk/waves-waste	2010	Marine litter	None

4.3.1 Developing understanding: linking social licence and citizen science

This discussion theme largely focused on developing understanding on the concepts of citizen science and social licence. Interviewees' responses to questions on their understanding of the concept of social licence provided insight into how the term might develop under a conservation context, i.e. as called for by Kendal and Ford (2018). Documenting how social licence is interpreted by different parties can guide theoretical development of the concept, by expanding and challenging definitions of social licence, and also by comparing how different communities perceive and 'make sense' of social licence (Parsons and Moffat 2014). Whilst the actual term 'social licence' was new to all but one of the interviewees, most of the coordinators were familiar with the sense of the concept, albeit under

different names; i.e. interviewees from the U.K. and Ireland synonymised it to '*buy-in'*, and '*public acceptance,'* and '*public pressure'* was another term used amongst interviewees.

There was strong support by all interviewees in favour of using citizen science to generate social licence for marine conservation. It was widely accepted that creating social licence would require specific project design and objectives and also highlighted that *'the first step in that is people have to care and be engaged with that kind of environment and citizen science definitely builds that sense of ownership…'(C2).* It was generally felt that social licence actions were already happening to some degree in many places, e.g. a petition to legally protect seahorses, and community resistance to coastal development plans.

Coordinators' understanding of the role of citizen science and social licence largely tied into themes discussed in other studies, i.e. citizen science can enhance scientific literacy, improve ecological knowledge, promote connections with nature and locality, strengthen social ties, and influence participants' sense of stewardship and environmental responsibility (Haywood 2015;Turrini et al. 2018):

> *'It comes back to the simple thing of bridging the gap and making them feel valued and having an important role in marine conservation, which is what citizen science does, it gives them that buy-in' (A4).*

Interviewees' understanding of the term 'citizen science' varied depending on the context or scope of their project. Terminology is particularly dynamic in citizen science because the field continues to develop, expand and diversify (Eitzel et al. 2017). Most coordinators did not wish to be restricted by a definition of citizen science and were keen to extend their projects more broadly and to partner with other schemes that did not necessarily conduct citizen science. One coordinator did, however, take umbrage with the term citizen science and preferred to use '*conservation volunteers' (B4)*, a term that he found was more accepted by his project's participants. He felt that use of the word science can discourage '*ordinary'* members of the public, who may feel they do not have a sufficient background in scientific research. Certainly, the meaning of citizen science can represent different things to different people and create confusion about its nature and utility (McKinley et al. 2017). We highlight that one of the challenges of using citizen science as a means to create social licence, is that the objectives of citizen science need to be transparent to participants (see 'Cooperation and partnerships' in Table 2). Defining these objectives with participants can be considered a project objective in itself.

4.3.2 Communicating: engagement and connecting stakeholders

The theme of communicating focused on the importance of engagement and data-sharing in opening science to the public, particularly the different means by which marine citizen science projects interacted with their participants and how participants shared this information more widely. Engagement and sharing knowledge about the marine environment were seen as a *'very strong purpose' (C2)* of marine citizen science. Modes and frequency of engagement varied widely (i.e. newsletters, seminars, beach-meets, training sessions, online forums, email updates, beachside billboards, etc.) and occurred frequently (often daily) to very rarely (largely due to funding or time constraints). Consistent with other studies, coordinators highlighted the value of personal and face-to-face communication with participants in developing rapport and for engendering meaningful relationships beyond transactional interactions (Martin et al. 2016c).

There was a large consensus that *'communication is key' (A4)*. Many coordinators underscored the role of the internet in their ability to share information and communicate efficiently with a wide public network and more easily for both participants and organisers. Social media (i.e. Facebook, Twitter) improved projects' ability to recruit participants and to remain in contact with them. For example, The Big Jellyfish Hunt is a project that communicates to its participants only through Facebook; Open Litter Map, one of the youngest projects in this study (established 2017), is also only internet-based. The importance of the internet for these projects is not surprising. Mobile technologies facilitate much broader participation in citizen science programmes that make use of developing technologies (Pimm et al. 2015). However, different marine user groups require different engagement strategies and projects must consider their own goals and capacities when designing and implementing participant engagement (Hind-Ozan et al. 2017). Social licence is founded on meaningful dialogue and communication (Yates and Horvath 2013), but exploration is required as to whether citizen science can best achieve this through face-to-face or digital media interactions.

Similarly to social licence, engaging the public in citizen science and involving them in data collection that informs management can legitimise data and generate trust in its validity and application (Aceves-Bueno et al. 2015). Data-sharing was an objective for several of the projects, particularly those who developed partnerships with government or academic institutions. Many projects provided data that was used in marine protected area (MPA) designations and now contribute to monitoring efforts within these MPAs. Others, such as the Secchi Disk Study, published their data in scientific papers in open-access peer-reviewed journals (see Seafarers et al. 2017). The ORCA Trust is the lead partner of

the European Marine Cetacean Monitoring Coalition, a consortium of eight cetacean-monitoring organisations across Europe that are '*collecting data to help inform policy and legislation, to improve the conservation of our marine space' (A4)*.

Sharing this data was seen as a major influencing tool for marine citizen science. It was agreed that '*people spreading the word' (B1)* and expanding awareness on data they collected or knowledge they learned through marine citizen science played a big role in disseminating information to the wider public (i.e. participants' families, friends and community networks). These observations align with other experiences in the literature, which show that volunteering in citizen science projects increases participants' concern about conservation issues and that participants disseminate the knowledge they learn to their wider social networks (Johnson et al. 2014;Nursey-Bray et al. 2018). Successful engagement experiences may generate positive perceptions and influence the development of trust and consequently, social licence (Dare et al. 2014). Citizen science data can educate already pro-environmental participants and help them disseminate and argue the importance of marine conservation amongst their wider networks (Cigliano et al. 2015). Context is key when seeking to obtain and develop social licence, and requires identifying and understand local and community needs and interest in order to aid communication and to build relationships with communities and marine stakeholders (Prno 2013;Hall and Jeanneret 2014), and social licence has been likened to 'an exercise in science communication' (Gallois et al. 2016).

4.3.3 Project logistics: community representation

Another theme identified in the interviews related to practical aspects of project logistics and successfully making citizen science happen. Funding was identified as a primary limitation to development and engagement by most coordinators. The funding sources that supported projects in this study varied greatly and included government grants, corporate sponsorships, scientific institutes, lottery funding, donations, membership fees, amongst others. Several projects had no direct source of funding whatsoever and these projects struggled to expand their engagement, recruitment and research activities. Citizen science can be a cost-effective means to gather data for scientific research (Aceves-Bueno et al. 2015) and there are numerous benefits of investing in citizen science development to enhance both scientific, social and political outcomes (Hecker et al. 2018b). Improving funding opportunities can enhance the likelihood of producing accurate and pertinent data for marine conservation. Overcoming funding challenges is critical to enhance the capacity of marine citizen science and its social and environmental impact (Schläppy et al. 2017).

Other limitations included meeting participants' expectations and incorporating diverse values into development: *'There's a lot of politics in conservation, as I'm sure you're finding out' (B4);* and successfully retaining participants that were recruited to projects: *'That is always a challenge, how do we get more people interested?' (C5).* These limitations further emphasise the need to increase availability of specific resources required for marine citizen science projects, that can enhance potential partnerships and promote public engagement. Communities invoke real power and increasingly, know how to use it (Boutilier 2014). Investing in marine citizen science can enhance project capacity to engage more widely with communities, and address societal concerns in its research, which can legitimise resulting data to communities and decision-makers, with the aim of improving understanding and ocean literacy that can enhance social licence for conservation.

4.3.4 Advancing citizen science: learning and understanding, and legitimacy

Developing marine citizen science projects to promote public awareness of marine issues and social acceptance of conservation was a strong subject in this theme. Whilst several of the projects were stagnant as a result of funding or other constraints, and others were only becoming established, all projects were hoping to develop and expand their scientific activities and engagement. Coordinators emphasised that marine citizen science is *'not a one-size-fits-all approach' (A5)* and that two-way communication between participants and coordinators is vital for developing projects that can be maintained successfully in the long-term. Legitimacy and accountability are crucial components of stakeholder and community perspectives (Johansen and Nielsen 2011). In advancing marine citizen science for the value of science and policy, planners must be careful to match their programmes' methods of engagement, public involvement and participation appropriately with their type the project and its focal aims (McKinley et al. 2017).

The coordinators discussed their project successes in improving people's understanding of marine species and ocean environments, particularly the success of marine citizen science in promoting ocean literacy: *'They always learn something new. They always get excited' (A2).* The majority of coordinators spoke of their very positive experiences of improved participant awareness and understanding and how this had changed and enhanced participants' perceptions of the marine environment. However, several did articulate concerns on whether citizen science projects outcomes have the potential to reach all members of the public, and the difficulties in retaining participants for longer time periods. These challenges are also felt in social licence issues, where some members of the public are more engaged than others and where the 'loudest voice' might not in fact be the most representative (Cullen-Knox et al. 2017). A further difficulty is that evolving social norms and

expectations will impact public acceptability and social licence for marine conservation (Dare et al. 2014). An objective for future citizen science and social licence research may be in determining how to ignite and sustain interest in marine science and conservation issues (Ballard et al. 2018).

4.3.5 People and partnerships: cooperation and partnerships, and connecting stakeholders

This theme was centred around engaging participants and partnerships from across society. Partnership-building with other groups and organisations was seen a means for projects to *'strengthen both the research data, the quality of the data we were getting and the engagement and messaging we were doing' (C2).* Citizen science can bring experts and non-experts together in partnerships that foster shared positive action to co-create knowledge and build understanding (Dickinson et al. 2012;Jordan et al. 2012) that can enhance social licence. Whilst levels of involvement and influence varied, benefits that projects sought and gained through partnerships included the ability to recruit more participants, more scope to engage with the public, enhanced ability to share data they collected and larger pools of funding to expand their projects' activities. In the UK in particular, many projects were affiliated with government agencies, which reflects their policy relevance (Owen and Parker 2018). Coordinators believed that the larger their project network, the larger the impact their projects activities could have:

> '*The larger the diversity with citizen science, I think, the higher are the chances it has an impact on social licence' (C4).*

Interestingly, participant types varied across and within projects, recruiting from *'every single walk of life, from dustbin men to scientists to all those in between' (B4).* This is consistent with a growing body of literature that recognises citizen science participants as diverse and representative of many kinds of people (Thiel et al. 2014;Cigliano et al. 2015). It is also a positive indicator of the potential of citizen science to engage a range of social sub-groups, which is necessary to develop social licence for conservation. This observation reflects the value of marine citizen science for engaging with a large body of the European public, building understanding and enhancing their ocean literacy, to enhance social licence for marine conservation efforts. Projects that recruit from populations with more diverse groups of age, attitudes and education are more likely to engage participants with varied views on conservation (Forrester et al. 2017).

We note, however, that other research suggests that a large proportion of marine citizen science participants are more highly educated than the general public (Martin et al. 2016d). Participants are also self-selected, and are likely to already hold positive views towards science and (or) conservation

before they engage in citizen science (Bonney et al. 2016;Martin et al. 2016b). This is certainly a pertinent area for exploration that would guide development of recruitment and engagement for citizen science in Europe and elsewhere. It is important to consider *who* participates in these projects when developing marine citizen science to enhance ocean literacy and improve social licence. Where developed appropriately, the participatory structure of citizen science can promote inclusion of diverse perspectives in decision-making processes (McKinley et al. 2017) and increase the legitimacy and social licence of decisions made in marine management.

4.3.6 Connecting: trust, marine citizenship, and stewardship

Creating ownership through citizen science and improving marine citizenship were seen as key outcomes of connecting participants to the marine environment. The interviewees largely agreed that marine citizen science is a valuable means to raise awareness and provide opportunities for the public to learn by doing and to connect them to marine environments they would not normally be aware of, or have exposure to. Participation in marine citizen science was considered a pivotal step for generating ocean literacy and reducing the *'disconnect between people and nature' (C5)*, to legitimise conservation and improve its social licence. However, there was consensus that developing marine citizen science for this purpose would require adequate planning to address these objectives. The coordinator opinions reflect others in the literature, on the need to properly understand the potential of citizen science as a communication and engagement tool (Groulx et al. 2017).

The process of earning social licence is similar to citizen science because it brings members of the public together to discuss and address issues of common concern. Citizen science is undoubtedly valuable in fostering environmental stewardship (McKinley et al. 2017) because participants most frequently have strong positive attitudes towards the environment, demonstrate pro-environmental behaviour, and believe that their actions contribute to the value of natural resource conservation (Merenlender et al. 2016). Stewardship also plays a role in social licence because it gives communities a 'voice' to oversee usage and development of their local environments and can instil public resonsibility for natural resources (Table 2) and develop marine citizenship (Figure 3). Projects in this study demonstrated that *'citizen science gives [participants] a closer relationship with their local environment, or whatever environment they're sampling from…ultimately gives people a greater understanding of the natural world and the environment in general' (B5).* Feelings of connectedness and ownership are known to increase participants' trust in the citizen science they are contributing to (Dickinson et al. 2012). These feelings of trust are also a major determinant in whether participants will award social licence or not (Boutilier 2014).

Marine citizen science was seen to legitimise marine conservation by connecting people to their local and/or marine environments and generating a sense of place through ownership of that space:

> *'It's more likely that people protect what they know and what they value' (A3);*
>
> *'It gives ownership to an area to stakeholders who normally feel disconnected' (B3);*
>
> *'I think that is very, very powerful, when you get the locals themselves caring about the marine environment' (B1).*

This is in agreement with other studies who have shown that people frequently need to personally experience the ocean (and its problems) before they are likely to change their views and attitudes (Steel et al. 2005). Leveraging this 'power of place' is posited as a valuable means to improve conservation decision-making and increase participation in citizen science (Newman et al. 2017). We identify this sense of place component as one that requires future exploration and development in the marine context (van Putten et al. 2018b), especially for enhancing marine citizenship. 'Marine citizenship' (i.e. an individual's rights and responsibility as regards the marine environment) necessitates increased awareness about marine issues, adequate understanding about the personal role and behaviour involved in creating and solving these issues and a positive shift in values that can promote ocean-friendly, pro-environmental behavioural decisions (McKinley and Fletcher 2012).

Ownership, developing ocean literacy and marine stewardship were seen as requirements for generating understanding and personal connection to the ocean, and trust in decision-makers managing marine spaces. Trust was an important topic strongly linked to communication because participants who continue to be engaged effectively will continue to trust citizen science projects and their outcomes (Hind-Ozan et al. 2017). This can legitimise research and the data collected, and increase the trustworthiness and social licence of the marine management decisions it informs. The project coordinators largely agreed that developing trust for marine conservation in Europe is a complex challenge that will need to be met with complex, complementing approaches because often, *'people trust what they want to hear' (C4).* Participants' interaction with scientists was seen as a way to legitimise data and decisions, again through personal contact and developing understanding of the processes and entities involved.

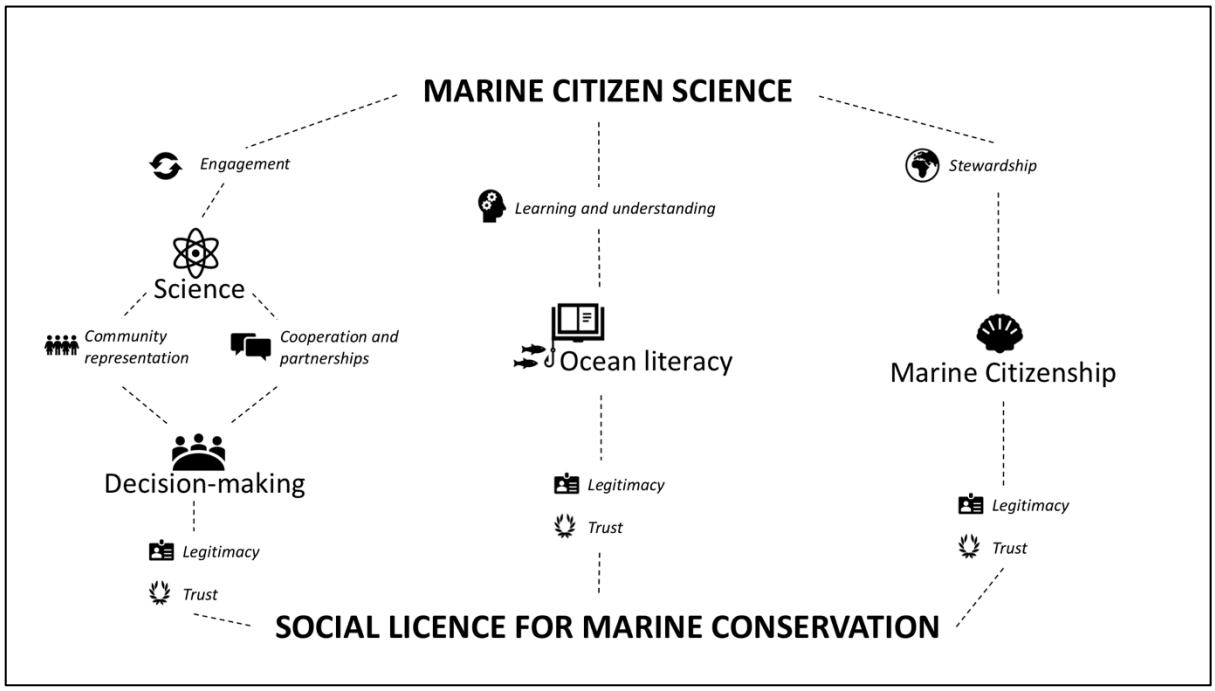

Figure 3. Marine citizen science legitimises science to the public and improves ocean literacy and marine citizenship to enhance social licence for marine conservation.

4.4 Discussion

Sustainable natural resource management and, in this case-study, marine conservation, require that management and policies are socially accepted. Public involvement in natural resource issues and decision-making is increasingly expected. Community ability to influence political decision-making, particularly through 'lobbying' activities, has set a precedent for the development of social licence in natural resource management (Cullen-Knox 2014), and promoting a need for social licence highlights the importance of community perspectives in conservation (Kendal and Ford 2017). Citizen science is one means of public engagement that can strongly improve social licence for marine conservation.

The results of our study are in agreement with others that have shown that citizen science can engage and inform the public about science and the natural environment and enhance empowerment to act (Martin et al. 2016c;McKinley et al. 2017;Nursey-Bray et al. 2018). Public engagement achieved through citizen science, via joint data collection and collaborative research, can innovate research and societal processes at the science-policy interface (Hecker et al. 2018b). This public engagement also provides an avenue to develop social acceptance, allowing communities and society to partake in and

influence policy development and decisions that will affect them (Soma and Haggett 2015). Establishing this dialogue with and between marine stakeholders is imperative to improve the more meaningful relationships underpinning social licence for conservation (Moffat and Zhang 2014).

Our interview analysis demonstrated that there is strong support in favour of using citizen science as a platform to develop social licence for marine conservation. However, these results represent the views and responses of citizen science coordinators only and are not representative of the wider marine citizen science community. Citizen science programmes provide opportunity for open discourse that is accessible to the public (McKinley et al. 2017) and our study demonstrates that citizen science can play a role in enhancing social licence for marine conservation (Figure 3) in Europe by:

I. Legitimising science: opening science to the public and creating joint evidence base for decision-making;
II. Improving ocean literacy: building participants' understanding about marine issues;
III. Promoting marine citizenship: connecting participants to the ocean.

We have determined that trust is a strong linkage between the concepts of social licence and citizen science. Legitimising research and use of the marine environment through citizen science increases the trustworthiness and social licence of the marine management decisions it informs (Boutilier 2014;Jijelava and Vanclay 2017). As discussed above, marine citizen science can legitimise marine conservation by connecting people to marine environments and enhancing their understanding of marine issues. Citizen science involves the public in data collection and decision-making that gives legitimacy to management decisions by increasing transparency (Reed 2008). Building upon legitimacy and community trust can help to create social licence (Boutilier et al. 2012). However, there is no 'easy' way to establish social licence (Prno 2013), it is a dynamic and ongoing process of community engagement actively seeking to maintain trust (Zhang et al. 2018).

Citizen science may also be an effective means to promote scientific literacy amongst the public (Bonney et al. 2009) and our study has demonstrated its value in promoting ocean literacy. Citizen science promotes reflection and discussion on how science interacts with society and societal values and how we can embed this more deeply into public thinking and decision-making (Storksdieck et al. 2016). Citizen science can foster broader societal impacts, especially in promoting conservation awareness because '*personal conversation is probably the biggest spreader of education' (B4).* Engagement achieved through citizen science can enhance flows and exchange of information between communities, scientists, marine managers and policy decision-makers to help produce

solutions that promote better environmental and social outcomes and therefore can help to mitigate conflict in natural resource management (McKinley et al. 2017).

There is widespread agreement on the need and importance of incorporating stakeholder groups and the public into marine conservation management through meaningful participation and engagement (i.e. Voyer et al. 2012;Brown et al. 2016). Citizen science is ideally placed for this engagement and can act as a catalyst for individual behaviour change that is linked to environmental stewardship of marine systems (Cigliano et al. 2015). In a similar way to which social licence provides a voice to communities (Boutilier 2014;Cullen-Knox et al. 2017), participation in citizen science can instil volunteers with a sense of ownership, both of the data they collect (Reed 2008) and the areas that they monitor (Newman et al. 2017). Fostering this connection and developing feelings of ownership can enhance marine citizenship and increase public support and social licence for marine conservation.

This paper has identified how marine citizen science may influence knowledge and opinions, connect diverse users of the marine environment and improve ocean literacy to improve social licence for marine conservation in Europe, and potentially elsewhere. In Table 2, we synthesised linkages between the concepts of social licence and citizen science which we hope can guide the development of further research on the role of citizen science in enhancing social licence. Another direction for future research could be to explore dissimilarities between the concepts of social licence and citizen science, and in what instances the concepts perhaps might not work to enhance one another.

As we have described above, social licence and citizen science are complex processes that both emerge from positive, potentially diverse, public engagement. For instance, social media has been identified as an emerging tool to earn and improve social licence (Yates and Horvath 2013). The transferability of our results to other disciplines is another avenue of research that could be pursued. There would also be value in obtaining participant views of citizen science, social licence, and marine conservation to complement this study because citizen science volunteers can represent a diverse range of people with various backgrounds and incentives to participate (Thiel et al. 2014). Recognising diversity and heterogeneity in the public's 'connection' to the sea is critical for addressing public needs appropriately in marine conservation engagement efforts (Jefferson et al. 2015).

The concept of social licence is useful because it recognises the importance and power of communities (Morrison 2014). In considering the need for a social licence, organisations (such as government agencies) can design agendas and actions that attempt to obtain public support and approval (Jijelava

and Vanclay 2017). We suggest that marine management and decision-making authorities consider marine citizen science as a tool to engage the public and work towards achieving support and social licence for their activities.

4.5 Conclusion

Obtaining social licence for conservation requires engagement with communities that promotes dialogue and cooperation (Zhang et al. 2018). Citizen science can be a means to foster this cooperation, by providing opportunities for individuals to participate in coordinated research efforts (Shirk et al. 2012). We have demonstrated clear linkages between citizen science and social licence which are useful for exploration and application not only in a marine context, but in the terrestrial space as well. We have highlighted how the concepts of social licence and citizen science influence knowledge exchange and development in drawing from sources in the literature and discussing the results of our study.

This study has identified how citizen science can foster synergistic effects to improve engagement, ocean literacy, trust and ultimately social licence for marine conservation (Figure 3). Participants in marine citizen science have the opportunity to learn and experience how science is conducted and how it contributes to conservation, decision-making and management and this can be a powerful, transformative and legitimising experience (McKinley et al. 2017). We propose that marine citizen science is strategically placed to promote trust and enhance social licence for marine conservation. Marine citizen science can serve as a valuable platform to connect the public to ocean environments, but it should not be assumed that participants will automatically support ocean protection or conservation management. Generating social licence through marine citizen science requires developing meaningful relationships with participants and earning their trust through engagement, education, sharing of information, dialogue and transparency. Achieving such objectives in Europe requires planning resources, staff and expertise, which many European marine citizen science projects do not have access to.

Our research supports growing policy calls that highlight the development of marine citizen science as an imperative objective to achieve engagement, ocean literacy and marine citizenship. In order to achieve these aims and to also enhance social licence for conservation, more opportunities for citizen science, including funding, will need to be made available. The costs of policy implementation associated with a lack of social licence can escalate rapidly across community, governmental, market

and environmental outlays. European marine conservation requires public awareness, understanding and social licence, and marine citizen science is a purposeful means to achieve this.

5

Citizen Science and Social Licence: Improving Perceptions and Connecting Marine User Groups

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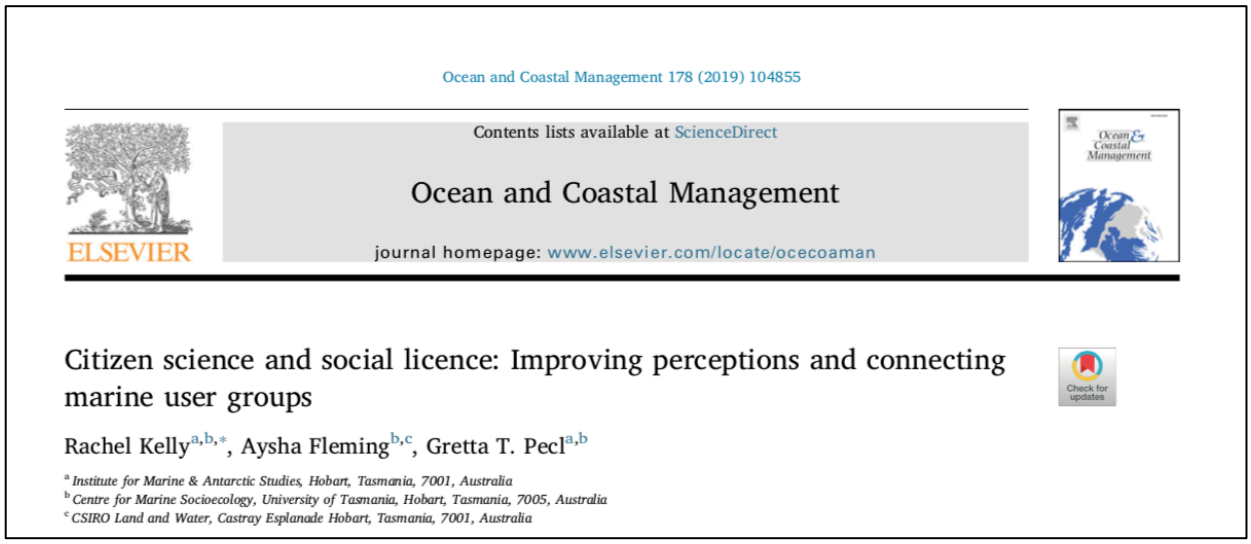
See Appendix G for the PDF of this published article. Note that here, the text and content of the paper remain intact but have been reformatted for the purpose of this thesis.



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Citizen science and social licence: Improving perceptions and connecting marine user groups

Rachel Kelly[a,b,*], Aysha Fleming[b,c], Gretta T. Pecl[a,b]

[a] Institute for Marine & Antarctic Studies, Hobart, Tasmania, 7001, Australia
[b] Centre for Marine Socioecology, University of Tasmania, Hobart, Tasmania, 7005, Australia
[c] CSIRO Land and Water, Castray Esplanade Hobart, Tasmania, 7001, Australia

5.1 Introduction

Ocean and coastal environments are intrinsically diverse and dynamic, complicated by varying scales and the multiplicity of stakeholders who use and enjoy them. These marine stakeholder groups have diverse relationships with the ocean and life within it, and incorporating their many social, economic and cultural values can create significant conflict and resistance in marine use and management. Such conflict can create distrust between stakeholder groups (Lester et al. 2017), making relationships between diverse groups a key point of tension in the marine environment (Boucquey et al. 2016).

Engaging with stakeholder groups requires recognition of their complex and diverse perceptions, attitudes and objectives, and social science approaches offer opportunities to engage with a broad marine stakeholder base (Spalding and Biedenweg 2017). Resolving conflict in the marine environment is often context-specific (Christie et al. 2017), but exploring 'people-to-people relationships' can advise mediators and marine managers towards achieving best outcomes and social licence (i.e. community acceptance or approval) for ocean and coastal management and for the stakeholder groups who share and use marine spaces and resources (Jones et al. 2016).

This paper builds on an expanding field of research which explores approaches and opportunities to achieve positive outcomes for science and society through citizen science (i.e. a partnership between the public and scientists to address questions and issues of common concern) (Danielsen et al. 2010;Kelly et al. 2019c). We provide insight into diverse processes occurring within citizen science and explore how the concept of social licence might be developed or facilitated through the citizen science experience. Previous studies have demonstrated that citizen science plays a valuable role in facilitating community engagement with natural resources and environmental issues (Nursey-Bray et al. 2018). Here, we use a case-study of the Australian marine citizen science programme Redmap (Range Extension Database and Mapping Programme) to investigate how citizen science may meaningfully include social uses and interests of diverse resource user groups, and whether it can promote exchange between these groups to improve perceptions and bolster social licence (i.e. social acceptance and support) for their activities in the marine environment. We investigate the potential for marine citizen science to be used as a tool to enhance engagement between, and social licence for, diverse marine user groups, i.e. whether social licence can be improved through participation in citizen science.

Social licence is not a formal or literal (paper) licence. However, it frequently co-occurs with formal legal requirements that explicitly require community input and consultation and thus, it is representative of community values and perceptions. It is a dynamic concept, 'an unwritten social contract' (Moffat et al. 2015) that signifies ongoing acceptance or approval from the community (Parsons and Moffat 2014), who are usually local residents or resource stakeholders, to access or use natural resources, i.e. the marine environment. It generally requires time and effort to achieve, and can be lost as community perceptions change and evolve over time (Yates and Horvath 2013). The concept of social licence has no legal standing, but this does not lessen its influence and the significant community power it invokes (Murphy-Gregory 2018).

More often than not, it is easier to identify where social licence is not granted than where it is (Yates and Horvath 2013). The intangible and impermanent nature of social licence renders it difficult to measure or monitor (Hall et al. 2014); however, good indicators include reduction (or absence) of vocal opposition to activities, continuing constructive conversation with communities, and willingness of communities and stakeholders to enter into dialogue and form partnerships. Interactions, conversation and meaningful engagement are integral to its developmental process (Rooney et al. 2014). Social licence can span local, regional and national scales (Dare et al. 2014), and it is likely to operate differently depending on context (Hall et al. 2014). We anticipate that much can be gained by exploring how social licence is potentially attained and/or developed through citizen science in the marine realm.

In the terrestrial literature, social licence has been depicted in various frameworks. These include the Pyramid Model (Thomson and Boutilier 2011) and the Three Strand Model (Morrison 2014). The origins of these two frameworks differ, but both interpretations rely on legitimacy that is based upon stakeholders' judgement of others' visible properties, behaviours and/or passive judgement based on cues from other stakeholders (Gehman et al. 2017). The Pyramid Model is founded upon legitimacy, but its apex is trust, which Thomson and Boutilier (2011) consider to indicate that an activity has low socio-political risk. In contrast, the Three Strand Model relates social licence to other forms of licences, but it also highlights the importance of trust in creating social licence. Morrison (2014) determines that trust is a component 'based on reciprocity', which is created and sustained by actively maintaining relationships with communities. Engaging with communities and stakeholder groups is critical for building trust and plays a unique role in achieving social licence at multiple scales (Dare et al. 2014).

Earning social licence requires bringing groups together to discuss and debate concerns and to improve community relations (Moffat and Zhang 2014;Lacey et al. 2017). However, to date, limited research has been conducted into the processes involved in obtaining social licence and the factors attributed to maintaining it (Moffat and Zhang 2014). Suggested actions towards generating social licence include timely and effective communication, meaningful dialogue, and ethical and responsible behaviour with regards to the use of natural (including marine) resources (Yates and Horvath 2013). Working with others facilitates knowledge exchange and allows parties to learn about one another. This learning is essential, in terms of social licence, to inform and promote the legitimacy of other groups (Boutilier and Thomson 2015).

Citizen science can provide a platform for diverse groups to address issues and questions of common interest (Thiel et al. 2014;Bonney et al. 2016;Kelly et al. 2019c). In a similar way to which social licence is founded on legitimacy, trust and the shared values that resource users and managers must operate by (Boutilier and Thomson 2015), citizen science 'comes alive' through networking and exchange between science and society (Bonn et al. 2016). The negotiation of social licence is inherently cooperative and a component of this is developing understanding by each group about other groups' perceptions and attitudes to issues of common concern (Gallois et al. 2016); i.e. the marine environment. We posit that citizen science is ideally placed to facilitate this, because it potentially connects groups to share experiences and to foster relationships that might otherwise not have opportunity to exist (Aceves-Bueno et al. 2015;Bonney et al. 2016). For example, Kelly et al. (2019c) identify several key attributes which link the concepts of social licence and citizen science, including 'representation' and 'connecting stakeholders'. Participation in citizen science, or other types of community-based monitoring, is one way that a group may potentially demonstrate responsible stewardship of a resource or demonstrate their role (and legitimacy) in contributing knowledge and information about a resource (Merenlender et al. 2016).

Public participation in scientific research and activities is not a novel concept (Bonney et al. 2009). Citizen science is an established means of engaging the public to collect and disseminate data for science (Bonn et al. 2016). It is distinguished as a valuable form of research because it expands scales of data and engagement (Newman et al. 2015) and facilitates more meaningful public interaction with science, as well as the application of new knowledge and data. The social licence literature describes how sharing perceptions, views and experiences can enlighten stakeholders on the experiences of other groups (Gallois et al. 2016;Jijelava and Vanclay 2017), and learning-by-doing is a characteristic of citizen science that we suggest can facilitate this exchange. Further, partnerships achieved through citizen science may create pathways for support between social groups and promote networks for collaborative decision making that can enhance outcomes for science and management (Danielsen et al. 2010).

The aim of this case-study is to explore the relationship between citizen science and marine social licence, in the context of marine stakeholder interactions. Both citizen science and social licence present promising means to develop dialogue between stakeholders involved in, affected by, or interested in resource use and development (Moffat et al. 2015). Citizen science projects have been demonstrated to improve communication and relationships amongst resource management and stakeholder groups (Shirk et al. 2012), but to date, large gaps remain in our understanding of the utility

of citizen science in a marine policy or social licence context. We explore how marine users interact with and legitimise one another, and how this relates to building relationships, to provide insight into how the concept of social licence (i.e. for marine user groups) might be developed or facilitated through the citizen science experience. Building upon current knowledge of the processes involved in creating social licence (i.e. not necessarily the outcomes), we explore whether marine user groups' participation in citizen science may provide opportunity to enhance (theirs and others') social licence.

5.2 Methods

In this study, we examined marine user groups perceptions of one another to investigate whether citizen science might play a role in informing and/or improving those perceptions and enhancing social licence. To increase our chances of obtaining views and perceptions from a broad range of marine user groups, we chose to combine two methods. We adopted this mixed-methods approach to obtain a more comprehensive understanding of our research enquiry than could be provided using either quantitative or qualitative approaches alone (Creswell and Plano Clark 2011). We implemented an online semi-quantitative survey of Redmap participants and built upon this by later conducting in-depth, semi-structured qualitative interviews. Human ethics approval for this research was authorised by the University of Tasmania, Australia in April 2017 (HREC ref: H0016442).

5.2.1 Redmap

Redmap is a website-based data-collection project, hosted across Australia, that calls on marine users to submit photographs and locational information on marine species that they have observed outside their expected geographical ranges. Marine scientists verify this information before it is added to the growing database of potential 'species on the move'. We selected Redmap as a model case-study for several reasons. First, as a marine citizen science programme it garners strong public interest because of the strong connections and close proximity of most Australians to coastal and marine environments (Nursey-Bray et al. 2018). Second, Redmap has defined scientific and social programme objectives. Third, Redmap is a web-based portal (www.redmap.org.au) and has a smartphone app, increasing its potential public outreach. The two primary aims of Redmap are:

1. To collate out-of-range species observations that can provide early indications of species that might be shifting geographically, possibly in response to changing environmental conditions such as warming waters associated with climate change (Pecl et al. 2019);
2. To educate and engage the community on issues around marine species range shifts and climate change. Redmap has been demonstrated to be a successful 'social learning tool'

(Nursey-Bray et al. 2018).

We note that participation in citizen science is often self-selected, and participants are likely to already hold positive views towards science and (or) conservation before they commence their involvement (Bonney et al. 2016;Martin et al. 2016b). However, citizen science volunteers in general can represent a diverse range of people with various demographic backgrounds and incentives to participate (Thiel et al. 2014). Redmap is an opportunistic (i.e. contributory) citizen science programme and no training is required to participate. These characteristics of the Redmap programme might reduce barriers to participation and the self-selection that is observed in other programmes. Regardless, we address any potential bias in our study sample by also including coastal community members from New South Wales, Australia (recreational fishers and divers and other marine users) who were *not* involved with the programme, as well as Redmap participants.

5.2.2 Questionnaire surveys

The first phase of this study consisted of a questionnaire survey of the national Redmap community, using the online survey platform SurveyMonkey. It was promoted through Redmap social media and remained open for three weeks during April and May 2017. The objective of the survey was to collect demographic information on Redmap participants, their activities in the marine environment, and their views on marine sustainability, and to recruit participants for the qualitative interviews. Participants from different demographics can be expected to have different perceptions and values in regards to the marine environment (e.g. women might express more concern about marine issues) (Eleiton et al. 2015), and in the case of this study, incorporating a more diverse demographic would infer that more perceptions are included.

The questionnaire survey included a mix of multiple-choice and open-answer questions, and these questions sought to identify the relative number of user groups (e.g., recreational fishers, divers, etc.) participating in Redmap and to obtain demographic information about the Redmap community, their geographic spread, and their participation in other local activities (see Appendix D). The consortium of Redmap participants have typically been considered as three distinct groups: fishers, divers, or boaters (Nursey-Bray et al. 2018). Some citizen science research suggests that participants typically come from factions of society, i.e. highly educated (see e.g., Martin 2017b), whilst other research contests that citizen science participants are representative of a wide range of demographic backgrounds (Thiel et al. 2014). These questions aimed to identify whether any demographic effects were apparent in our sample of participants. Other questions sought to identify majority user groups and explore participants' perceptions of the Redmap programme; e.g., why they participate and

whether this has enhanced their interest in marine sustainability in Australia. Questions about perceptions of the Redmap programme sought to understand whether participants thought that other Redmap participants shared their values of the marine environment and marine sustainability and whether they believed these values were distinct from that of the wider population.

5.2.3 Interviews

Following the online survey phase, several interviewees were identified (i.e. they volunteered) from the questionnaire survey respondents, whilst the others were identified via snowball sampling; i.e. initial informants (marine educators, marine community leaders, etc.) were identified and the subsequent interview sample was built by asking for recommendations from these people (Young et al. 2018). The interviewees were sampled from local communities in the townships of Eden, Merimbula and Port Stephens, all in the state of New South Wales, Australia. The sample included interviewees from i) the Redmap participant community, and ii) members of the broader marine community who did not participate in the Redmap programme. A total of 33 semi-structured interviews were conducted by the lead author in November 2017, mostly in person (n=26). However, Redmap participants who had volunteered through the online questionnaire survey and were located elsewhere were interviewed over the phone (n =7). The sample size used in this study is typical of qualitative case-study research. We follow the precedent set by other studies, where participant samples of approximately 30 are generally considered suitable (Marshall et al. 2013;Saunders and Townsend 2016).

Interview methods can provide insight on stakeholders' knowledge, values and beliefs (Young et al. 2018), and the interviews described here aimed to capture the views and perceptions of Redmap participants, as well as other coastal community members who did not participate in Redmap. The interview questions were semi-structured, i.e. standard questions were asked in each interview to allow comparison, but the interviewer could also probe with other questions if an interesting or relevant line of enquiry developed during the interview conversation (Young et al. 2018). This format allowed for some differentiation between the questions asked to Redmap and non-Redmap interviewees. The Redmap participant interviewees were probed with questions that explored their perceptions of the Redmap programme and its role as a platform to connect user groups because, as discussed above, facilitating and promoting community engagement is a necessary precondition to developing social licence (Yates and Horvath 2013). In contrast, the community members were interviewed to explore whether their perceptions differed from Redmap participants and whether they had interest in the concept of the Redmap programme and might participate in the future. They

were asked whether and how they currently interact with other marine users, what influenced their opinions, and whether they would like to participate in citizen science in the future.

Other questions that were similar for both groups queried interviewees' understanding on the concept of social licence, to identify differences and similarities in knowledge and understanding, and to determine whether interviewees perceived Redmap as a mean to promote engagement and dialogue that could facilitate the development of social licence. The ambiguity associated with social licence may represent opportunity in its development and expansion towards stakeholder engagement (Fleming and Howden 2016), and the questions around social licence were designed to understand how marine users interpret and perceive social licence, to potentially guide theoretical development and discourse (Parsons and Moffat 2014). Documenting how social licence is understood by communities is beneficial for identifying criteria and conditions for achieving and assessing it, and for comparing how different groups or communities enact and 'make sense' of social licence (Parsons and Moffat 2014). A full list of survey and interview questions is provided in Appendix D.

The interviews lasted between 10-40 minutes and were audio recorded and transcribed professionally before being analysed by the lead author. To protect the confidentiality of all participants, all participant names were replaced with identity codes (as used for quotations below). All interview transcripts were analysed using NVIVO 11 qualitative data analysis software (QSR International). Initial codes were generated, then themes were developed iteratively using a grounded theory approach (Haywood 2015). This allowed for the interview findings (i.e. themes) to emerge from the data without restrictions imposed by more structured approaches (Hay 2010). These were reviewed, compared and redefined to capture where relationships between codes were identified. The final themes were obtained and organised through hierarchical coding.

The resulting key themes identified below represent the aggregated interview responses, as opposed to the questions that guided them. These thematic results focus on topics discussed in the interviews, including social licence, perceptions, conflict and aspects of the Redmap programme. Qualitative interviews can provide insight into 'the meanings that individuals and groups attach to experiences, social processes, practices and events, for example, by policy decision makers' (Edwards and Holland 2013), and here, interviewee quotations are used to elucidate and describe the themes that emerged from our analysis. The interviewee quotations used below are intended to be descriptive, and not representative, of marine user group perceptions.

5.3 Results and thematic discussion

5.3.1 Questionnaire survey

In total, we received 142 responses from the open survey call (56% male; 44% female). The questionnaire survey respondents could identify themselves as more than one 'type' of marine user. They self-identified primarily as divers (57%), fishers (51%) or naturalists (51%). Other user types identified included boaters, surfers, snorkelers, beachgoers and conservationists. This result confirms that of other research, determining that Redmap involves many different marine user groups, and some who might not typically engage in citizen science (Pecl et al. 2019). This is interesting to note because diverse stakeholder involvement in citizen science projects can enable broader and more effective uptake of the data collected, improving knowledge exchange around environmental issues (Göbel et al. 2016) and increases the likelihood that citizen science can support an open and informed society (Craglia and Shanley 2015). This is important for guiding future development of citizen science, and also for identifying stakeholder groups when working to develop social licence.

Participants engaged with Redmap largely out of personal interest, i.e.

> *'I enjoy the ocean so much and am interested in what is moving into our area'* (RX11);
>
> *'[I'm] interested in the impact of climate change on marine life'* (RX33).

Eagerness to contribute to scientific impacts and learning were also motivations to participate in the programme, participants were enthusiastic and engaged with the Redmap programme:

> *'It is useful to know what is happening in our local waters and to know which species have been found in Australian and Tasmanian waters which don't belong there. To help understand what the warming waters is doing to our marine life'* (RX4);
>
> *'I value our oceans and want to support the scientific community'* (RX14);
>
> *'It's good to keep people informed and see what is being found'* (RX2);
>
> *'I gain a lot of insight from the information. I also understand the movement of species which I can identify in my local marine environment and appreciate how amazing they are'* (RX20).

91% of respondents said that they found Redmap social media to be educational, and more than 75% stated that they had recommended the Redmap programme to someone else, including friends, family and club members and through social media posts online, which confirms previous research on the Redmap programme; Nursey-Bray et al. (2018) identified that 78% of participants had recommended Redmap to someone else. In fact, 62% confirmed they had shared information which they had learned through Redmap social media to other people. Redmap respondents had a strong view that they were a group who were more strongly concerned with marine sustainability issues than

the general public (91%), and 55% indicated that their engagement with the Redmap programme had further increased their interest in marine sustainability. Further, Redmap participants' consensus view that they are a group distinct from the larger public has interesting connotations for dialogue and engagement around social licence, because participation in Redmap infers a sense of legitimacy to other participants, regardless of their activity within the marine environment.

Open-answer survey responses to questions about marine sustainability showed that Redmap participants (63%) felt that most Australians are concerned about sustainability but that the public are largely ignorant as to the extent of problems in the marine environment:

> *'Marine sustainability is not high enough in general awareness. I think people see beautiful beaches and think, 'everything's fine''* (SX5).

Despite this, responses showed that Redmap participants were optimistic about public concern for marine sustainability and highlighted that education would be the primary route towards improving public understanding and support:

> *'They're concerned, but not necessarily in ways that are realistic. More, ongoing, community education is essential'* (SX44);
>
> *'Increased education is vital'* (SX17);
>
> *'I think people are crying out for information about marine resources that is written in plain English'* (SX83).

5.3.2 Interviews

There were more male interview participants than for the surveys; twenty-one (63.6%) men and twelve women (36.4%). Distinct from the online questionnaire survey phase, the interviewees represented Redmap participants and non-Redmap participants. Of these interviewees, 36.4% identified that they had participated in the Redmap programme. Thus, the representation of marine user groups differed; 27% identified as divers, 45% as fishers and 33% as other, again which included boaters, surfers and snorkelers. No observable contrast between the opinions of Redmap and non-Redmap participants was recorded, variability of opinions occurred across the entire group of interviewees. The majority of non-Redmap participants stated that they would be interested in participating in the programme in the future. Redmap participants noted that their observation of other marine user groups participating in Redmap had improved their perceptions of these groups (e.g. divers' perception of fishers):

> *'[Redmap participants] at least have an understanding of the species and are more switched on. And a bit more caring about the environment'* (KS_13N);

'I'm actually heartened a bit to see them there because I tend to lump everyone in the same category and I know that's wrong…It's nice to see that fishermen are participating' (KW_13N).

Social licence issues that interviewees had observed personally included opposition to marine parks, strong community acceptance of recreational fisheries, and community resistance to aquaculture development and fishing trawlers. The survey respondents and interviewees shared consensus that education and interaction through citizen science would be a primary means to improve public understanding and social licence for marine user groups. Hierarchical coding analysis of the interview transcripts identified four general themes which were discussed by the stakeholders: *marine groups' perceptions of one another, marine user conflict, views and potential of the Redmap programme, and social licence for marine user groups. Marine groups' perceptions of one another* was the most commonly identified theme, with 96 references, whilst *marine user conflict* was the least discussed, with 22 references in the interviews. These four themes were structured from the accumulated interview responses, as opposed to the questions that acquired them, and are explored and interpreted more deeply below, where we elucidate the survey and interview results, using key quotations from the data transcripts and their context to the relationship between citizen science and social licence.

5.3.3 Marine groups' perceptions of one another

In consensus with previous studies on Redmap, divers and fishers constituted the primary users of Redmap and also the primary marine users represented in the interview analysis. However, interviewees' overwhelmingly perceived recreational fishermen as the most dominant marine user group. This might be because New South Wales is a hub for recreational fishing in Australia (West et al. 2015) or that recreational fishing is a much more visible activity on the water than diving, because diving activity in New South Wales is also recorded at very high numbers (AustralianSportsCommission 2010). Further, these two user groups had very distinct opinions about one another. Fishers were regarded as a dominant group and environmental attitudes of recreational fishers were perceived to be:

'*Changing, compared to what it was, say 20 years ago. A lot more are aware of the environment itself'* (GT_14N).

Whilst many did regard fishers '*just like any other group'* (PW_13N), others thought that *'they kind of run their own show'* (KK_5D). By and large, however, interviewees recognised that it is a small percentage of the recreational fishing who inform the poor perceptions of the general public:

'There's always a small population that gives the rest of us a bad name' (BL_20N);

'It's that one percentage' (BL_14N).

The general view of divers was that they were a 'green' user group, *'more sort-of conservation focused'* (AB_20N), who *'keep to themselves a bit'* (GT_14N). The segregation of user groups was clear, and distinct cultures were identified that maintained each group's own identity. Interestingly, several of the survey respondents and interviewees identified themselves as both fisher and diver, demonstrating that these groups are not in fact as separate as they might appear to be; i.e. there may be overlap between recreational fishers, and recreational and extractive (e.g. shellfish or lobster) diver groups. Largely, interviewees were open to the idea of interacting with other marine groups, if the opportunity arose, but that '*would have to happen off water'* (AB_20N). Misinformation was seen as the biggest barrier towards creating trust between groups and *'becoming more aware'* (DW_13N) was a common sentiment as to how bridges between these groups might be developed:

> *'A small minority may ruin it for those people but I think the main thing is, understanding what that group needs or what all the other groups need and being able to work with them on that'* (TW_22N).

Redmap is ideally positioned for such interaction because participants can interact on its online platforms (e.g. website, Facebook, Twitter, etc.) and can discuss issues away from the marine environments which they so often contentiously share.

5.3.4 Marine user conflict

Interviewees' opinions about conflict varied across experiences, however they largely agreed that conflict was something unavoidable:

> *'There's always going to be conflict'* (DH_4D);
>
> *'That's the thing in the community, everyone's got a different opinion on how it should* be' (JM_14N).

The most distinct conflict observed amongst interviewees was that between (non-extractive) scuba divers and recreational fishers:

> *'Fishers don't like the divers and the divers don't like the fishers'* (DH_4D).

If community groups can better understand each other, they may support more considered, developed and balanced opinions and perceptions of other groups, and their values which can promote fruitful discussion and positive outcomes for marine management. Social influencers were identified as a means to promote credibility, legitimacy and trust for marine groups, all prerequisite steps to earning social licence (Boutilier 2014):

> *'You would need some influential popular people on that group to bring about social licence, definitely'* (KW_13N).

Citizen science provides opportunity for open dialogue which a broader community of users can access, comprehend and trust (McKinley et al. 2017). In the case of Redmap, it also removes participants from potential physical sites of conflict:

> *'If they've got issues with other user groups you've removed that usual confrontation area, which is, "I'm in my spot, you're coming into my spot" type thing. Whereas when you're sitting behind a keyboard at home or on your phone, you don't have that'* (TW_22N).

Interviewees thought that programmes like Redmap are a platform to '*get the different user groups talking'* (MH_7D) and to connect and legitimise them based on their common interest of the marine environment.

5.3.5 Views and potential of the Redmap programme

In this study, participants recognised the unusual nature of Redmap's broad engagement, appealing to *'different sectors that often are in conflict'* (AJ_21N), and value in providing *'factual information that people can access'* (NG_7D). Redmap engagement was seen in a positive light by interviewees who were familiar with the programme; this is consistent with previous assessments in which participants identified Redmap as a forum through which they can access new information (Nursey-Bray et al. 2018). Citizen science has been shown to foster environmental stewardship, prompting participants to care more about their environment (Ballard et al. 2018) and increase intention to engage in pro-environmental activities (Crall et al. 2012). For instance, engaging with citizen science programs can facilitate more positive perceptions of resource management and of user groups, and in this study, participation in Redmap was perceived positively by the participants, as a demonstration of responsible stewardship:

> '*They would be more likely if they're into conservation'* (JB_15N).

One way to foster stakeholder connections through citizen science is to tap into existent networks within projects' communities to recruit new participants (Haywood 2015), e.g., fishing, diving clubs, tackle shops, etc. Citizen science participants are known to share the information they learn through citizen science and many intend to adopt new behaviours as a result of the learning they experience through these programmes (Dean et al. 2018;Nursey-Bray et al. 2018). This may be further bolstered by identifying social influencers or champions who are trustworthy sources of information within the community, who can share information that is trusted and can improve community understanding and acceptance of other marine user groups. Redmap has already engaged volunteers to act as champions, and this engagement has been shown to meet the needs and interests of marine users

who are keen to share information about citizen science (Martin et al. 2016b). Further, Redmap involves many different marine user groups, some of whom might not typically engage in citizen science (Pecl et al. 2019).

5.3.6 Social licence for marine user groups

'Finding some common ground' (TN_20N) was seen as a primary requirement for connecting and engaging stakeholders in developing social licence because it requires being perceived as legitimate (Boutilier 2014). Both facts- and values-based drivers play a role in determining whether social licence in give or withheld (Cullen-Knox et al. 2017). Interviewees were very much of the opinion that:

> *'You've got to prove that you are trustworthy, a sustainable user of the environment, and that you're willing to work with those other user groups'* (TW_22N);
>
> *'…engage with key stakeholders to provide them with information that they probably didn't know about'* (CB_21N).

Further thoughts around social licence focused on what the term meant for participants, whether they had observed it in action in their local areas, and how social licence for marine user groups (e.g., recreational fishers) might best be achieved. There was a strong sense that social licence action was necessary and already happening, across a range of community issues. Interviewees identified social licence as:

> *'Social acceptance for the thing you're doing'* (CY_15N);
>
> *'That big green tick [public acceptance] is something that people want'* (RC_20N).

The concept of social licence is a continuous process to be sustained through repeated interaction and positive engagement with other marine users and stakeholders, and marine user interactions facilitated through participation in citizen science foster and encourage new social bonds (Haywood 2015):

> *'People value people. And I think people would give out their social licence certainly more when they are informed and involved in that'* (AB_20N).

Whether diverse perceptions of marine users are based on truth or not, research demonstrates the participation in citizen science can connect people with each other and with natural environments through emotional and reflective experiences that can empower them (Cigliano et al. 2015;Haywood 2015;Groulx et al. 2017). Citizen science provides opportunity for interaction between potentially like-minded members of different user group communities (Dickinson et al. 2012):

> *'I think that Redmap and facilitating that kind of conversation between fishers and other users is a really good way to generate social licence. I a hundred percent agree with that'* (AB_20N).

Creating social licence requires knowledge and meaning-making (Rooney et al. 2014) and citizen science can facilitate this for marine users by promoting interaction with other user groups. Participation in Redmap improved perceptions of trustworthiness amongst marine user groups and supports the inference that participation in citizen science can create shared understanding that engenders social licence for diverse user groups, including recreational fishers:

> *'Getting different user groups talking to each other, I think is really helpful'* (MH_7D);
>
> *'Redmap is the kind of thing that would bring them together'* (JM_20N).

Interviewees did acknowledge the difficulty in engaging the broad community of marine users and that having a platform, such as Redmap, '*is going to be critical'* (AJ_21N). Engaging with diverse marine user groups requires different communication techniques and strategies (Hind-Ozan et al. 2017). In citizen science, challenges exist for all stakeholders, which require designing, promoting and supporting programmes that incorporate the wider community in their activities (Martin 2017b).

5.3.7 Future directions and limitations

There are certainly potential overlaps between the concepts of social licence and citizen science (Kelly et al. 2019c), and the results of our study demonstrate linkages that are observed through Redmap. We note, however, that the design of Redmap promotes inclusion of different marine user groups from the broader community who might not otherwise be formally engaged or willing to be involved in citizen science (Pecl et al. 2019). We have investigated a specific case-study of Redmap Australia, and thus, there may be several limitations in applying this knowledge to the wider citizen science community, including:

- Cultural – we engaged with marine stakeholders, who might have different views and/or perceptions to citizen science participants and community members of more inland regions.
- Temporal - at the time the surveys and interviews were undertaken, no major conflicts existed in the marine communities we engaged with (that we are aware of). Thus, the interviewees might have been more open to engage with other groups at this time, than when a major conflict had been rife.

Still, the outcomes of our study provide fruitful insights on perceptions and views of trustworthiness between marine resource user groups, that can help to advise future developments in the growing fields of citizen science practice and citizen science research. The findings of this study are directly relevant to how social licence might be facilitated in other contexts and highlight citizen science as both a novel and useful tool to explore further in developing social licence in the context of marine

management. Future research that could enhance progress in this space includes identifying why people participate in citizen science programmes such as Redmap, whether there are other marine stakeholder groups that might not be engaged through citizen science, and whether there may be other participatory approaches to engaging with communities and enhancing social licence, apart from citizen science. Exploring who constitute the participants of citizen science (Martin et al. 2016b), how these participant groups interact and how they engage and communicate around the process of social licence, may also generate knowledge that can better inform human dimensions of ocean conservation (Kelly et al. 2017). Better understanding of the views and perceptions of key stakeholders engaging in citizen science can help to explain the dynamics of citizen science (Vann-Sander et al. 2016) and its potential influence on marine space social licence and ocean and coastal management.

Programmes such as Redmap have high potential to act as a mechanism that instigates behavioural change towards, for example, the fishing sector, environmental issues, and/or stewardship because they work beyond supplying factual information and actively engage community members about environmental issues (Dean et al. 2018). Citizen science programmes are ideally positioned to connect diverse participants and groups together by focusing on a common problem or goal, and this can foster new knowledge and improve networks of communication between stakeholders (McGreavy et al. 2016). Marine stakeholders are a complex and diverse mix of people and engaging with them will require recognition of their diverse values, perceptions, attitudes and objectives. This study has identified citizen science as a tool to improve marine user groups' perceptions of one another and to gain legitimacy, trust and social licence for their activities, which can improve deliberation and outcomes for marine management.

Our study proposes that marine user groups' participation in citizen science can improve how they are perceived by other groups and enhance their legitimacy, which fosters social licence (i.e. social acceptance and support) for their activities in the marine environment. Marine citizen science is established as a means to engage the public in marine research which can contribute valuable knowledge to science and society (Martin et al. 2016b). Previous studies have determined that citizen science is a platform on which community members can contribute to solutions for better environmental management outcomes and collaborate to avoid unnecessary conflict (McKinley et al. 2017). Marine user groups' participation in citizen science also provides an opportunity for them to improve and display their marine citizenship (McKinley and Fletcher 2012) and to portray themselves more positively in the views of other users.

5.4 Conclusion

The concept of social licence has many components (Parsons and Moffat 2014) and in this study, we focused on trust, legitimacy and relationships. We identified the potential for citizen science to be involved in creating and building social licence, but not necessarily the outcomes of achieving it or maintaining it. The results of this case-study demonstrate that marine citizen science

I. provides opportunity for marine users to connect with one another,
II. can improve their understanding of other user groups, and
III. can reveal their shared values of the marine environment,

towards improving different user groups' perceptions and acceptance of one another's activities. We have shown that participation in programmes such as Redmap can improve perceptions of trustworthiness amongst marine user groups.

Social licence has popular appeal because it conveys the notion of community acceptance and support (Bursey and Whiting 2015). However, it is important to recognise that social licence does not equate to one group dominating over another. Achieving social licence can demand a flexible approach that is responsive to diverse interests from a range of stakeholders (Yates and Horvath 2013). There is certainly benefit to be gained (and earned) by all parties if built collaboratively through mutual sharing, dialogue, understanding, learning and collaboration and the results of this study suggest that citizen science can provide such a flexible and inclusive approach. As the results of this study have shown, engagement with marine stakeholders is based on complex and diverse perceptions, attitudes and objectives, and interaction between marine user groups can be improved through their participation in marine citizen science, with potential applications for marine management. This study is important because we included the perceptions of citizen science participants as well as the broader marine community. However, we did not examine the relationships and engagements that actually occurred in Redmap, and this is an area of research where further exploration is required.

The results of this study show that marine user groups considered citizen science as a means to improve public understanding and social licence for their activities. The themes presented in this paper can be built upon in developing marine citizen science programmes that can engage diverse user groups and interest. In particular, developing social licence through citizen science may have positive implications for marine management by providing 'common ground' on which to create some shared understanding and engender social licence for diverse user groups. This exploration of citizen

science as a tool to connect and engage diverse stakeholder groups can direct future research, to guide the development of new citizen science programmes and objectives.

Social licence is a dynamic concept and, in this instance, is a continuous process of repeated interaction and positive engagement with marine users and stakeholders. Interdisciplinary cooperation between the natural sciences, who conceive and implement citizen science programmes, and social sciences, who have greater capacity to evaluate these programme outcomes, will be key in the advancement of citizen science and in its potential for engagement and development of social licence in the marine realm.

6

Social Licence for Marine Protected Areas

All of the research contained within this chapter is currently under review as:
Kelly, R., A. Fleming, M. Mackay, C. Garcia, and G. T. Pecl (2019). "Social licence for marine protected areas".

6.1 Introduction

The marine environment is a shared public resource and the success of marine conservation worldwide depends on stakeholder approval and support. The human dimensions of marine conservation are thus increasingly recognised as important, and the ocean is heralded as the next frontier for natural resource conservation and development (Bennett 2018). However, these developments are hindered by complex and disparate marine management arrangements, diverse social values, and dispute and conflict over competing resource use (Voyer et al. 2017). Furthermore, relationships between diverse stakeholder groups and ocean spaces are often a focal point of tension in marine planning and protection (Boucquey et al. 2016). Improving engagement with the social components of marine management could potentially provide a means to address these challenges, and public participation in marine decision-making is becoming widely accepted as necessary (Stephenson et al. 2017).

Social science methods that engage with stakeholders can help to develop the trust and support necessary for achieving effective communication and policy change (Spalding and Biedenweg 2017). Social licence indicates community acceptance and support for the use and management of natural resources, and is gaining currency in stakeholder engagement and sustainable management in the marine realm (Voyer et al. 2015a;Kelly et al. 2017). No consensus definition of social licence exists to date, and it is unlikely that one will be achieved in the near future. Here, it is considered ‘an unwritten social contract’ (Moffat et al. 2015) that is increasingly used to describe the implicit acceptance of communities, in regards to various uses of natural resources, including the ocean (Hall et al. 2014;Kendal and Ford 2017).

Social licence is not an actual, physical (i.e. legal) licence (Yates and Horvath 2013), but it enables communities to exert significant influence on natural resource decision-making processes through engagement and negotiation (Prno 2013). As such, the concept continues to evolve and present new

questions for research (Measham and Zhang 2018). This study does not focus on expanding the theory of social licence, rather it aims to explore its practical application in the context of marine protected areas (MPAs), both in actual terms and potential. For other more detailed discussion of social licence in a marine and conservation context, see Moffat et al. 2015;Kelly et al. 2017;Kendal and Ford 2017;Garnett et al. 2018;Kelly et al. 2018;Kelly et al. 2019c;Mather and Fanning 2019).

6.1.1 Marine protected areas

MPAs are 'clearly defined geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve long-term conservation of nature with associated ecosystem services and cultural values' (IUCN 2008). The global number and spatial extent of MPAs is increasing (Christie et al. 2017), largely in attempts to conserve 10% of coastal and marine environments by 2020 (ConventionOnBiologicalDiversity 2010). However, implementation of 'successful' MPAs has proved difficult (Rossiter and Levine 2014) and at the time of this study, only 4.8% of global marine areas were protected (MPAatlas 2019). MPAs are socially-defined and constructed and thus, require social, economic and political support to achieve their aims. Despite increasing evidence of the benefits of MPAs for biodiversity conservation (Edgar et al. 2014;Marshall et al. 2019) and improved socio-economic conditions for local communities (Yates et al. 2019), other evidence suggests that MPAs are ineffective in addressing threats to the modern marine environment (including fisheries) and are possibly even detrimental to effective marine conservation and management (Kearney et al. 2013). Scientific consensus on what constitutes a 'successful' MPA is lacking (Giakoumi et al. 2018), due to paradoxical differences of opinions within the marine conservation community (Agardy et al. 2003). As a result, designation of MPAs remains problematic because they frequently lack community understanding, support and social licence (Voyer et al. 2015a).

This paper posits that marine management and policy could benefit from an investigation of social licence for MPAs, and the concept is applied as a frame to examine how social licence exists and can potentially be developed in practice. In doing so, a constructionist approach is adopted to develop this contextual understanding of support and social licence for MPAs, to produce relevant insights that can improve MPA success more widely. First, a brief review of the history of public support and opposition to MPAs in Tasmania is conducted to highlight key events that resulted in the current moratorium on MPAs. Then, the case-study is developed in the context of social licence, explaining the chosen methodological approach, and discussing the results of the data collection and investigation. Finally, a framework is developed from these results, and the outcomes of the study are discussed and related to i) current perceptions of MPAs in Tasmania, and ii) broader understanding of

social licence for MPAs. The framework focuses on developing social licence, and aims to advise marine managers, decision-makers and stakeholders dealing with issues of conflict and opposition in Australia and elsewhere.

3.1.2 Case-study site: Tasmania

Tasmania is Australia's only island state, located 240km south of the mainland and separated by the Bass Strait. The island lies within a temperate marine region that has been geographically and climatically isolated from other temperate systems for almost 65 million years and as a result, Tasmania has high levels of marine diversity and endemism (Parsons 2011). The state is internationally recognised for its diverse terrestrial ecosystems, including the Tasmanian Wilderness World Heritage Area, and over 50% of the island's land area is protected in parks. In contrast, 7.9% of Tasmanian State Waters is under protection, with only 1.12% designated 'no-take'. Tasmania's marine environment is also under Commonwealth MPA management but this study focuses on perceptions of State MPAs only (Figure 4).

Tasmania has a history of intense social and political polarisation around environmental issues (Lucas and Warman 2018), and conflict on the use and conservation of marine and terrestrial resources has endured for decades. Historically, the economy in Tasmania has been linked to extraction and export of natural resources (e.g. fish products, timber), including marine resources (e.g. historically, sealing and currently, fisheries and aquaculture), and in recent years, these resources have increasingly been exploited by the tourism industry (see e.g. Tourism Tasmania). In parallel, community groups have disputed and challenged resource exploitation and development and in 1972, the United Tasmania Group was established as the world's first Green Party.

Conservation issues in Tasmania remain highly politicised (Stump and Kriwoken 2006). In 2015, the Tasmanian Liberal (i.e. centre-right) Government imposed a moratorium on expanding the MPA system, which remains in place today (TasmanianLiberals 2018). It followed a contentious MPA designation process for the Bruny Bioregion, where wider community negotiations were challenged by a minority group who ultimately lobbied for an oppose result that did not reflect wider community interests. Even though a majority of Tasmanian fishers conditionally supported the expansion of the MPA system, primary opposition was from minority commercial and recreational fishing groups, who argued the potential cost to fisheries and recreation (Stump and Kriwoken 2006). From a social licence perspective, this outcome was not unusual because the loudest and best resourced group(s) often drive social licence, even where their views are not representative of the wider community (Cullen-Knox et al. 2017). The challenge then, in developing of social licence, is to determine how best to

engage and incorporate wider community views. Below, social licence for MPAs in Tasmania is explored through an investigation of current marine stakeholder perceptions, and a cyclical framework is developed from these insights to delineate how social licence might be achieved in practice.

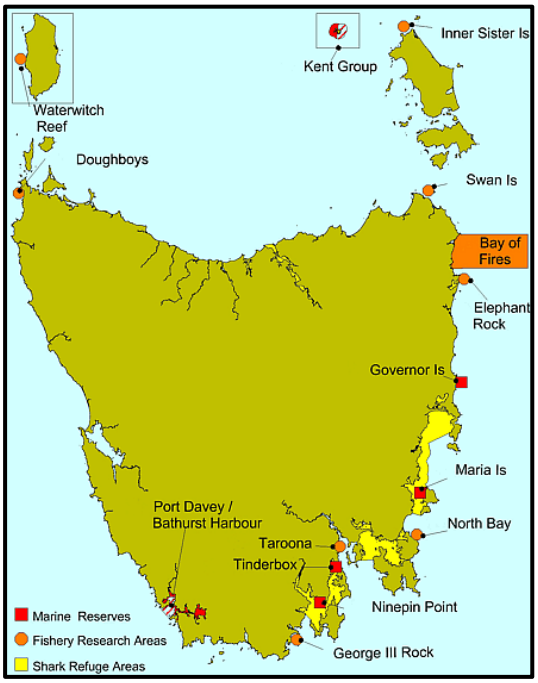


Figure 4. Map of Tasmania, with current MPAs identified (DPIPWE TAS 2014).

6.2 Methods

6.2.1 Q-method

As an emergent concept in the marine realm (Kelly et al. 2017), it is beneficial to explore social licence through qualitative and interpretive social research (Leith et al. 2014b). Research that explores the perceptions (i.e. knowledge, views, insights and attitudes) of local people can provide important insights into understandings and interpretations of the social impacts, and ecological outcomes of conservation initiatives, such as MPAs (Bennett 2016). This study combines Q-methodology with qualitative interview analysis. Q-method was selected because it is aligned to produce outcomes that can inform policy decisions; it captures subjective opinions of a set of participants (i.e. rich insights) to provide understanding on the diversity and quantity of perceptions held by the participant sample (Ellis et al. 2007).

Q-method integrates qualitative and quantitative techniques to reveal social perspectives and is increasingly used in marine environmental research (see e.g., Gall and Rodwell 2016;Farrell et al. 2017;Carr 2019). It is a useful evaluation tool because it allows for systematic study of subjectivity, as well as communicability of perceptions, on the discourse of a specific topic (Du Plessis 2005). Thus, it is an appropriate method for addressing a research question that involves investigating multiple perspectives (Ramlo 2015). Q-method seeks to identify shared views, particularly on topics that are debated and contested (Eden et al. 2005), making it a suitable approach to study the social licence of MPAs, an oftentimes debated and contentious issue for marine stakeholders.

In Q-method, participants (the P-set) are asked to rank a set of statements (the Q-sample), according to how they agree or disagree with those statements. This ranking process is called a 'Q-sort', and the Q-sample must be something that the P-set are likely to hold an opinion on (Webler et al. 2009). Interviews are a useful source from which to derive a concourse (i.e. a set of discourse in conversation, media and/or text around an issue) for the Q-sample. In this study, interviews with key Tasmanian marine stakeholders (i.e. managers, fisheries representatives, recreational divers, commercial operators, etc.) undertaken by CG in 2014-15 were used (García 2017). Although the Q-sorts were conducted five years after these interviews, it was assumed that the lack of change in regards to the moratorium, and development in regards to marine conservation management in Tasmania, rendered these interviews pertinent and valid. The interviews further validated the participants' Q-sorts. The P-set (n = 21) were strategically selected from marine user and management communities in Tasmania, based on their knowledge and background in Tasmanian marine environmental affairs. The Q-sorts lasted between 20-30 minutes, and in each case, were followed by a semi-structured interview. For a detailed explanation of the Q-method approach and analysis, see Appendix E. Human ethics approval for this research was authorised by the University of Tasmania, Australia in January 2019 (HREC ref: H0017840).

6.2.2 Interviews

Q-method studies can aid participants to understand their own thinking on issues, thus in this study, the semi-structured interviews were conducted immediately after each participant completed their Q-sort. Interview data can provide insight on stakeholders' knowledge, values and beliefs (Young et al. 2018), and the interview questions (Appendix F) sought to understand participants' understanding and support of MPAs in a Tasmanian context. Perceptions portray how a person 'observes, understands, interprets, and evaluates a referent object, action, experience, individual, policy, or outcome' (Bennett 2016)(p585). Several questions specifically explored participants' understanding

of social licence and their views on social licence for MPAs in Tasmania, and sought to provide insight as to how social licence might be developed in a conservation context (Kendal and Ford 2018;Kelly et al. 2019c). Identifying how social licence is understood by diverse groups can inform its theoretical development, by expanding current definitions and comparing how different stakeholders and communities understand and perceive social licence in practice (Parsons and Moffat 2014).

The interviews lasted between 25-55 minutes and were audio-recorded before being transcribed professionally. All interview transcripts were subjected to analytical evaluation, again using NVIVO. Q-method is distinct to other forms of qualitative research in that its subject matter cannot be broken into themes (Watts and Stenner 2005). Thus, the interview analysis did not code the transcripts into themes, but rather identified descriptive insights to elucidate the factors and further develop the social perspectives identified in the Q analysis. The interview analysis more deeply revealed stakeholders' perceptions of MPAs, as well as their understanding of the concept of social licence. This is explored and interpreted below, where the combined results are presented using key quotations from the interview transcripts. To ensure the anonymity of the participant responses, all interviewee names associated with these quotations are replaced with identity codes.

6.3 Results

6.3.1 Factor 1 - I use the ocean: MPAs are not the solution

Factor 1 explained 29% of the total variance with 17 distinguishing statements (Table 4), and there were 14 significantly loading sorts. These sorts were representative of researchers, managers, recreational divers, and commercial and recreational fishing agents. Fundamental to this perspective was a complete rejection of the view that Tasmania has one of the worst MPA systems in the world (statement 16; ranked 4). The interviews revealed that this view was not based on a belief that Tasmania has a good MPA system, rather that other countries and regions have worse systems. This result was interesting because it demonstrates that the stakeholders have a strong worldview, and also that they are have good understanding about MPAs, both Tasmanian and otherwise.

There was an appreciation that MPA management centres around people and relationships and showed a desire to protect the ocean (5; 2). However, this perspective strongly believed that MPAs are not the only strategy for marine environmental protection in Tasmania (22; 3):

> *'They're a tool. I don't think they're the be all and end all for marine conservation'* (AD24);

disregarded the need for no-take MPAs (20; -1), and did not see MPAs as a critical tool for protecting the marine environment (18; -3):

> *'It's made to sound as though MPAs are going to solve all of our problems in the marine environment, but clearly from someone who has spent half their life in this space…it is not going to do anything like that'* (A4);
>
> *'Saying you have an MPA. And what does it actually do? The difference between proclaiming an MPA - and actually achieving the outcomes that MPA was designed to achieve - is an entirely different concept'* (A4).

A central component of this perspective also, was the agreement that the ocean is a resource to be used and enjoyed; having personal access to the ocean is critically important (4; 4), and the ocean is an important food source (3; 3). The factor exemplar (i.e. the Q-sort that most strongly loaded on that factor) informed this perspective further in their interview:

> *'Fundamentally, we're all conservationists at heart. We all want to protect the ocean because, from our point of view, it provides an income, livelihood and employment and food on the table, return to communities, financial return to communities in Tasmania. And without protecting the ocean, none of that can occur'* (AB24).

This perspective identified with the cultural importance of the ocean in Tasmania (6; 2), both for its intrinsic biodiversity value (1; 2) and its economic value in providing jobs (2; 2). However, whilst the value of the marine environment was appreciated, there was also strong belief that the ocean is not central to the lives of most Tasmanians (19; 1):

> '*People are quite disengaged and they have views and perceptions about [the ocean] that quite often are misinformed or they don't understand the full extent to it'* (AB24);
>
> *'I think some people don't actually even care'* (A15);
>
> *'I think that's where the big challenges lie, how do we tap into the people who are more informed?'* (A4);

and additionally, that there is a vocal minority who drive the conflict and politics around marine resource use in Tasmania (15; 1):

> *'There is vocal minority who has a particular view and they don't mind telling you what their views are'* (AB24);
>
> *'There are some really passionate voices out there' (A15);*
>
> *'It does become very awkward at times because of the vocal minority. They're the only ones that you ever hear about' (A29).*

6.3.2 Factor 2 - No one listens: we need MPAs to protect the ocean

Factor 2 explained 19% of the total variance (Table 4). The sorts that loaded significantly were representative of researchers, managers, conservation organisations and recreational fishing agents. Commercial fishing parties did not load significantly on this factor. In contrast to Factor 1, this perspective did not develop the personal connection to the ocean, but rather focused on a need to protect the ocean as a natural resource and asset. It centred around the desire to protect Tasmania's environment into the future (17; 2):

> *'If we want to hold onto the environmental values that we have, that a lot of us hold dear, we do need bigger MPAs'* (A11).

It completely disregarded any risk that MPAs might pose to marine fisheries (10; -4), and did not value the ocean highly as a source of food (3; -1). Statements that focused on the ocean as culturally or economically important were mid-ranked (6, 2; 0), as was the desire to engage with other stakeholders (8; 0).

In juxtaposition to Factor 1, this perspective strongly viewed no-take MPAs as necessary (20; 4):

> *'I think a proper MPA is the primary goal' (A11);*

and critical to protect the environment (18; 3) and provide *'major benefits'* (AB17). However, whilst the desire to protect the ocean in MPAs was strong, this perspective did not feel adequately involved in marine decision-making processes (7; -3) and believed that the government did not support marine conservation (30; 1):

> *'The Liberals will never be supportive of marine parks. They're not supportive of any conservation'* (AB17).

This perspective strongly felt that it is difficult to achieve real conservation outcomes in Tasmania (28; 2):

> *'I don't feel that the decision-making process actually really incorporates the different stakeholders' views'* (A8);
>
> *'The government and the fishing industry are both big hurdles for protection in Tassie' (A11);*

and saw that conservation issues in Tasmania are highly politicised (25; 1) by a vocal minority who are not afraid to share their views (1; 1).

Table 4. The Q-statement ranking (-4 to 4) assigned to the two factors, i.e. social perspectives, with the distinguishing statements for Factor 1 indicated with *.

Theme	No.	Statement	F1	F2
Values	1	Tas marine environment is unique and diverse	2	3
	2	Tas' marine environment provides local jobs	2*	0
	3	The ocean is an important source of food	3*	-1
	4	Having access to the ocean is important to me	4*	1
	5	I would choose to protect the ocean	2	2
	6	The ocean is culturally important in Tas	2*	0
Stakeholders	7	As a marine stakeholder, I feel included in decision-making processes	0*	-3
	8	I'd like opportunity to interact with other stakeholders	0	0
	9	In Tas, people are afraid to be in one camp or the other	-2	-1
	10	MPAs might have detrimental effects on commercial fisheries	1*	-4
	11	The conservation groups in Tas are definitely pro-MPAs	-1*	1
	12	Conservation organisations don't have much political influence	-1	-1
	13	Commercial fishers are very influential because the industry is worth a lot of money	0	-1
	14	Rec fishers are important stakeholders because they represent a lot of votes	0*	-2
	15	There is a vocal minority who tell you what their views are	1	1
MPA support /opposition	16	Tas MPA system is pathetic - it's one of the worst in the world	-4*	-2
	17	We need to think about protecting Tas' marine environment into the future	0*	2
	18	MPAs are absolutely critical to protect the marine environment	-3*	3
	19	The marine environment is out of sight and mind, a lot of people don't understand	1*	0
	20	We need no-take MPAs in Tas	-1*	4
	21	It's hard to know what people think about MPAs	-2	-3
	22	MPAs are not the only strategy for marine environmental protection	3	2
	23	MPA management is about people and their relationships	1	0
	24	I look to my peers to understand their views on MPAs	-1*	-2
Political climate	25	Conservation issues in Tas are highly politicised	1	1
	26	Plans to establish new MPAs will continue to be problematic	0	0
	27	After the forest problems, people don't want another problem	-2	-2
	28	It's very difficult to achieve real conservation outcomes in Tas	-2*	2
	29	Tas MPAs don't have social licence from the fishing industry	-1	
	30	The government don't support marine conservation	-3*	1
	31	Tas politicians don't want to lose votes so they've banned MPAs	-1*	1
	32	A lot of Tas politics occurs behind closed doors, we don't know what is discussed	0	-1
	33	The media have created political divides in Tas	1	0
		Explained variance (%)	**29**	**19**

6.3.3 Consensus between the social perspectives

A particularly insightful use of Q is to clarify what different groups might agree and disagree on, thus providing direction on how groups can move forward in future discussions (Webler et al. 2009), e.g.:

'Just to have that conversation, because I think ultimately people want the same thing. They want a healthy marine ecosystem for the future. They just have very different ways about going about it' (AB12).

The analysis identified 16 consensus statements between the two factors, significant to 0.01. Consensus statements represent those that did not distinguish between the pair of factors, and can be considered the shared perspective amongst all participants. Both factors strongly valued Tasmania's marine environment (1; ranked 2,3 respectively) and would choose to protect the ocean (5; ranked 2 by both):

I think there is a common thread that they do at their heart, whether they're relying on that recreationally or commercially, or even from a conservation perspective, value the environment. It's just a matter of finding a middle ground that's acceptable to everyone' (A8).

There was also consensus on the view that MPAs are not the only strategy to achieve this protection (22; 3, 2):

'MPAs are not the only strategy for marine environmental protection…MPAs are critical but there are other strategies. They all have to work in concert' (A8).

The two views believed that it was not hard to determine what different stakeholders think about MPAs (21; -2, -1), and that the vocal minority would certainly tell you what their views were (15; 1,1).

6.3.4 Social licence

The interview data revealed that stakeholders had a very good awareness and appreciation of the concept of social licence:

'It's a general community acceptance of a particular activity or undertaking' (A8);

'It's certainly about having the community on board' (AB15);

'The confidence of the community in anything' (A29);

'Social licence is a level of acceptance and authorisation from a community to participate in an activity, where people take a view that, by and large, the benefit will exceed the cost' (A4).

These understandings provide insight that may guide theoretical development of the concept of social licence. The stakeholders identified the focal position of community in social licence, inferring the importance of community participation in marine decision-making. They believed that social licence was, and would be, a challenge in developing MPAs or any other form of marine management. Further, they felt that the wider Tasmanian community was poorly informed about marine issues and

the marine environment in general. The interview data revealed common challenges in developing social licence, e.g. engaging and informing stakeholders:

> '*People have a perception MPAs will protect the oceans. But they don't have the deeper understanding that they're just artificial lines on the water that don't actually protect anything'* (AB24);
>
> *'I think marine literacy and marine governance literacy is pretty low amongst the Tasmanian population'* (A5);
>
> *'If you said "Marine protected areas", most people will just say, "Oh, that sounds good" or, "Oh, no, there's no fishing", with no detail, no nuance to the argument'* (AB15);
>
> *''The thing with MPAs from my perspective is that most people probably, in my experience, don't really understand it'* (A29);
>
> *'Because if you're just an average person on the street and it's not your area, marine parks seem to make a lot of sense you know, so I'm not surprised that everyone gets confused'* (AC17).

Social licence is a useful frame through which to examine MPAs because it positions communities as important stakeholders and collaborators (Leith et al. 2014b). The results above delineate several challenges in developing social licence, including engagement, education and diverse views. Building on these, a cyclical framework (Figure 5), denoting that social licence is a continuous process (Parsons and Moffat 2014), is constructed here and six key stages in developing social licence are identified:

1. Understand perceptions
2. Identify consensus
3. Engage (other) stakeholders
4. Develop dialogue
5. Build trust
6. Maintain discussion.

Whilst these stages are elaborated below based on the results of the case-study investigation, it was not within the scope of this study to empirically test this framework in practice. However, the theoretical insights provided may be applied more generally to MPA and marine planning processes elsewhere, where the framework can be developed and adapted further through practical application.

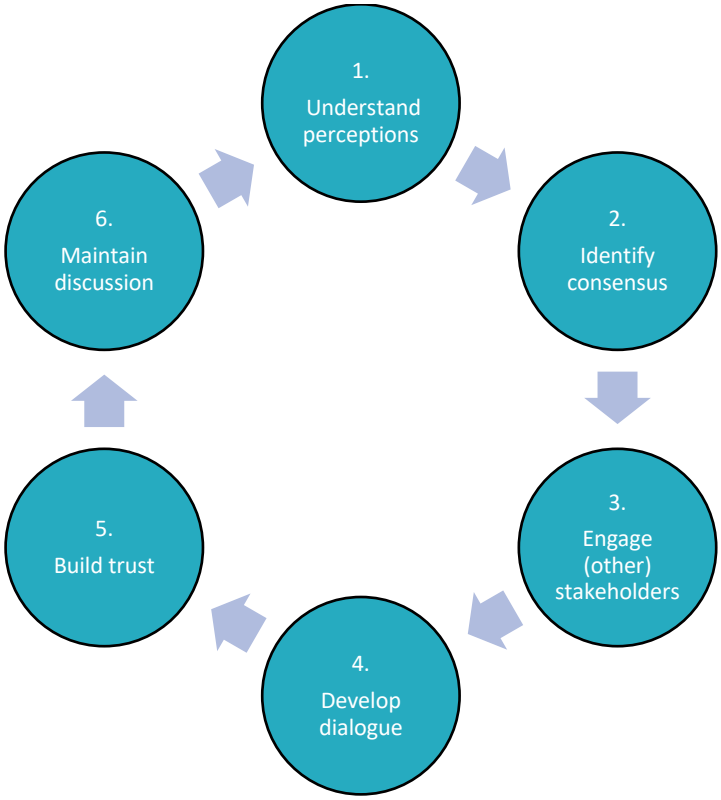


Figure 5. Schematic framework developing social licence for MPAs.

6.4 Discussion

It is important to understand stakeholder knowledge and opinions when devising new marine policy (Lester et al. 2017). This study applied Q-methodology, combined with interviews, to explore perceptions of support and opposition (i.e. social licence) for MPAs in Tasmania, and identify insights that can advise policy. This methodology identified two social perspectives; *I use the ocean: MPAs are not the solution;* and *No one listens: we need MPAs to protect the ocean*. The consensus statements highlighted shared views that participants can potentially agree on in developing dialogue moving forward (Webler et al. 2009). The most important result from the Q analysis was that there was no support/oppose divide in regards to MPAs.

Recognising a need for social licence highlights the importance of public and community perceptions in natural resource management and conservation (Voyer and Gladstone 2015). The social perspectives revealed that social licence for MPAs is highly nuanced and incorporates multiple perspectives and values. This corroborates other research on social licence that considers it 'a holistic and multidimensional concept' (Jijelava and Vanclay 2017)(p1084), and also highlights the importance

of documenting stakeholders' social, cultural, historical perceptions in attempting to understand how and why stakeholders will support or oppose an initiative (Dehens and Fanning 2018). The key stages of developing social licence are outlined below, with reference to the Q-method and interview results. The goal of this framework is not to develop social licence for a particular outcome (i.e. community acceptance of MPAs), rather to provide opportunity for understanding, engagement and stakeholder dialogue, that might generate equitable and sustainable marine management outcomes (i.e. contextual community deliberation on the most appropriate marine management approach).

6.4.1 Understand perceptions

The two social perspectives revealed that the stakeholders fell into two groups, one that wished to sustainably use the ocean, and another whose desire was solely to protect the ocean. A challenge in achieving social licence is that stakeholder networks are divided, and some groups may support an activity whilst others oppose it (Boutilier et al. 2012). In this case-study, however, neither group were vehemently opposed to MPAs. Even though it might appear that the perspectives divide the stakeholders into supporting/opposing MPAs, the highly-ranked statements revealed that it is actually more nuanced. Both groups valued the marine environment, although they had different views on how to manage it sustainably. The perspectives provide unexpected insights into marine stakeholders' perceptions and opinions on MPAs and marine management, and highlight the importance of understanding perspectives before attempting to develop engagement or dialogue further.

Here, the perspectives revealed that stakeholders did value the marine environment (albeit in different ways), that they believed wider community engagement in marine issues was inadequate, and also that a vocal minority drove social licence for MPAs in Tasmania, as opposed to the community at large. These results in particular, are significant because they reveal that the stakeholder community might not be as polarised as expected. Polarisation is often implicated in debates around conflict and social licence for natural resources (Lucas and Warman 2018). The results here reveal considerable overlap between the stakeholder perspectives and could likely provide opportunity for constructive dialogue when following and executing the cyclical framework.

6.4.2 Identify consensus

A common problem in attempting to earn social licence is that the stakeholder network is internally divided (Boutilier et al. 2012). The challenge for stakeholders involved in polarised discourse, such as MPAs, is to be willing and able to recognise the legitimacy of divergent values within the community, and to communicate through means that do not further confront these conflicting values (Lucas and

Warman 2018). In the context of this study, the nuanced perspectives and consensus statements are a positive result, that might provide 'common ground' to enable groups to engage in fruitful discussion around marine management into the future (e.g., Kelly et al. 2019b). Q-method, amongst other benefits, can assist decision-makers and stakeholders in resolving conflict (Carr 2019) and in this instance, provides insights on consensus points. Incorporating both perspectives by focusing on commonalities can bring groups together to develop engagement and relationships.

The consensus statements revealed that the two perspectives are not entirely distinct from one another, and demonstrate that social licence for MPAs requires more nuanced understanding. The consensus statements (e.g. 1,5,6) and interviews show that both perspectives would choose to protect the ocean because they strongly valued Tasmania's marine environment, inferring that a strong sense of place was felt by both groups. Sense of place is influenced by changing uses of the environment, including MPAs (Sowman and Sunde 2018), and could be a constructive point that might be targeted and developed upon in future stakeholder engagement (see van Putten et al. 2018b).

6.4.3 Engage (other) stakeholders

In Q-method, participants are chosen because they have knowledge and opinions about a topic (Webler et al. 2009) and here, the participants' knowledge about marine issues informed their deeply considered views, and provide an explanation for why the perspectives were not distinctly support/oppose. Informed stakeholders can deliberate their views based on sound knowledge, and contribute to positive outcomes for decision-making (McKinley et al. 2017). The stakeholders in this study believed that the wider community did not understand ocean issues and are thus poorly informed to contribute to decision-making around MPAs. They also highlighted the difficulty in engaging communities and stakeholder groups, a common challenge in marine management because meaningful community engagement and dialogue are central to developing social licence for that management (Dare et al. 2014;Rooney et al. 2014;Yates et al. 2019):

> *'How else do you get social licence? You try and get more people involved and start more conversations. Because I think there's the big mass of people that are just not engaged'* (AB12).

This engagement must be timely, inclusive and meaningful (Yates and Horvath 2013), in order to create the positive experiences needed to develop dialogue and trust (Dare et al. 2014). Vested interests can hamper decision-making processes (Kelly et al. 2019a) and drive unequal power relations between stakeholder groups (Flannery et al. 2018). Thus, developing social licence through engagement requires a dynamic approach that can be responsive to stakeholder needs and values

(Yates and Horvath 2013), and the perspectives and consensus statements identified above can provide insight on how best to approach and develop topical conversations with and between stakeholders. In polarised discourses, such as MPAs, stakeholders are challenged to acknowledge the legitimacy of their divergent values (Lucas and Warman 2018), and successful engagement can play a central role in creating collaborative community relationships (Zhang et al. 2018;Voyer and van Leeuwen 2019) that develop with, and despite, divergence. For example, marine citizen science is a means to bring diverse marine groups together, potentially connecting stakeholders to legitimise one another, and enabling them to participate in constructive discussion (Kelly et al. 2019b).

6.4.4 Develop dialogue

Obtaining social licence cannot be achieved without engaging these stakeholders and developing dialogue (Zhang et al. 2018). It was surprising that, although Tasmania is an island state, stakeholders felt that a majority of people are not adequately educated about the ocean (i.e. ocean literate; see Costa and Caldeira 2018) to engage in informed dialogue about marine issues. In order to be effective, marine management efforts must work to facilitate meaningful stakeholder participation and create space for dialogue and debate (Flannery et al. 2018). Social licence requires knowledge and meaning-making (Rooney et al. 2014), and the framework outlines how stakeholders might be engaged in meaningful dialogue following successful engagement in practice. For example, scientific knowledge can become a tool for researchers to inform and engage stakeholders, and positively influence marine management (Billing 2018). Marine conservation researchers could play a role in developing dialogue with communities around marine issues, to improve their understanding of marine issues and conservation (Kelly et al. 2018).

Increasing community knowledge through dialogue can also improve marine citizenship, and engender positive 'ocean-friendly' attitudes that are more likely to understand and support marine conservation efforts (McKinley and Fletcher 2012;Kelly et al. 2019c):

> *'People who are informed make better decisions, obviously'* (A29).

Stakeholder support/opposition is not only constructed from lack of awareness or understanding, but also reflects stakeholder values, wider cultural contexts, and perceptions of truth, thus it would be naïve to presume that engagement and knowledge sharing can simply and conveniently include all stakeholders fairly and meaningfully (Flannery et al. 2018). The framework must be continually evaluated and adapted to promote inclusivity and legitimacy in marine management dialogue.

6.4.5 Build trust

Trust is an essential component of social acceptance and social licence (Prno 2013;Edwards and Lacey 2014;Moffat and Zhang 2014) that is built on effective engagement and meaningful dialogue with stakeholders (Yates and Horvath 2013). In the context of MPAs, two aspects of trust should be considered:

1. Trust between stakeholders: degrees of trust can influence how they will legitimise one another, and how social licence will (or will not) be achieved (Jijelava and Vanclay 2017). The perspectives in this study revealed that stakeholders shared some similar values, which could be a means to legitimise one another (Kelly et al. 2019b).
2. Stakeholder trust of marine management: it is not 'truth' that wins debates, but rather the stakeholders best able to assert and direct their narrative in public dialogue (Ellis et al. 2007). It is vital that stakeholders are engaged and educated about other perspectives and sides of the debate, if their choices (and social licence) are to be properly informed.

Trust, in a social licence context, is founded upon legitimacy and credibility (Thomson and Boutilier 2011). Engagement and dialogue with and amongst marine stakeholders will be necessary to develop trust between them. Trust-building takes time, thus efforts to build trust were not within the scope of this study. Understanding stakeholder perspectives and experiences can help to create positive perceptions experiences for developing it (Moffat and Zhang 2014). Recognising shared values of the marine environment, as identified above, might allow stakeholders to foster dialogue and behaviours that can earn trust. The results of this study confirm those of others in identifying *engaging stakeholders* and *developing dialogue* as key to developing trust and social licence (Rooney et al. 2014). Whilst effective stakeholder engagement is central in building trust (Dare et al. 2014), transparency is also critical to maintain legitimacy and credibility (Boutilier and Thomson 2015). Trust is based on reciprocity and can only be sustained through actively maintaining relationships with communities (Morrison 2014).

6.4.6 Maintain discussion

Maintaining stakeholder involvement can increase social acceptability of MPAs (Gall and Rodwell 2016) and in this instance, challenge where MPAs might be perceived as useful or not in the eyes of stakeholders. Good indicators of social licence include continuing and constructive stakeholder dialogue (Yates and Horvath 2013). The framework described above can direct future discussion around MPAs, and other marine developments, by revealing social perspectives, developing dialogue,

and highlighting the complexities within each. There are 'no short cuts' in attempting to develop social licence for MPAs (Yates et al. 2019)(p85).

At present, there is no major drive or directive pushing for new or expanded MPAs in Tasmania. However, in light of current global targets and increasing pressures on governments to protect the ocean within MPAs, it is likely that MPAs will become a planning and management objective in Tasmania in the future. Early assessment of community support is critical when attempting to create an MPA (Thomassin et al. 2010) and maintaining community discussions and relationships will be key to such assessment. New management plans will also require fruitful stakeholder engagement to develop successful marine conservation, not necessarily through MPAs (Gleason et al. 2013;Davies et al. 2018;Sowman and Sunde 2018):

> *'One of the things I would advocate for in Tasmania is a much larger and integrated approach to marine and coastal spatial planning that allocates uses for a range of activities and values, broader than just MPAs'* (A5).

Evidence from the literature suggests that management is likely to be more successful when stakeholders (and managers) can agree on shared goals, and develop collaborative approaches to achieve these aims (Sowman and Sunde 2018). The consensus statements identified above present themes on which to develop conversations, and opportunities to create shared goals and agendas.

The framework contributes to the development of a 'new vision' of sustainable marine management (Kelly et al. 2019a)(p12), by outlining how stakeholders can be engaged to develop dialogue, and to also potentially address power dynamics. Challenges in developing and implementing MPAs are largely shared with challenges felt in marine spatial planning and other management approaches and the lessons learned here can further our knowledge and improve future marine management initiatives (Ban et al. 2012). Monitoring stakeholders' perceptions of MPAs can help to identify future development and management actions, including relationship-building, communication, outreach and increasing transparency (Bennett et al. 2019). Thus, the social elements of marine management should be considered equally as important as the ecological elements, when working to achieve objectives (McNeil et al. 2018).

6.4.7 Limitations and future directions

Tasmania provides a modern example of marine use debate in the western world, and local stakeholder perceptions and concerns are likely to be shared with other stakeholders in other regions of the world. This study provides novel insights on how these perceptions can be explored and

understood in the context of social licence. Q-method requires a focus on informed stakeholders, and favours small participant samples. Thus, it was not within the scope of this study to include perceptions from the wider community, particularly from those who might be less engaged and informed. Future research should attempt to include views and insights from the wider population, to more fully garner how social licence for MPAs might be influenced by other stakeholder groups into the future.

No Indigenous perspective was included in this study. Attempts to liaise and include Indigenous views and input proved difficult, owing to disparate western research and Indigenous culture worldviews. However, recent efforts by Aboriginal Tasmanian peoples to reframe their relationships with government are creating space for negotiations and developing new rhetoric (TebrakunnaCountry and Lee 2019). First Peoples' involvement in natural resource management can identify views and needs that might otherwise remain excluded, and positively influence more comprehensive marine management approaches (Davies et al. 2018). Future studies could hopefully be more successful in this effort to include Indigenous views, and obtain a more complete perspective for decision-makers working to achieve sustainable marine management arrangements. Attention should be given to whose values are included and prioritised, as well as who is excluded in marine management processes (Flannery et al. 2018). The framework should only be applied following careful consideration of the values and cultures of marine stakeholder and community groups.

6.5 Conclusion

To date, most research on support for MPAs has focused on the dichotomous support/oppose debate on social licence for MPAs. In contrast, the Q-method analysis presented in this paper revealed that social licence for MPAs is much more nuanced, and identified commonalities and shared perspectives that can be built upon in developing future marine management. In this regard, social licence may have potential application as a tool to improve marine management and conservation, by improving engagement around diverse stakeholder interests, and building upon consensus points and interests. Q-method may be applied in future research on social licence for MPAs, to build upon the knowledge and insights gained here.

Social licence is a complex concept (Yates and Horvath 2013) and this study did not attempt to simplify it, rather provide insight into how social licence might be achieved in practice. Although this study focused on social licence for MPAs in Tasmania, Australia, the cyclical framework can provide guidance for those seeking to develop social licence, not only for MPAs but potentially in other contexts, and in

other regions of the world. This framework is intended to be a starting point for fruitful conversation and development, and will likely be adapted as it is applied to marine management in practice. Future efforts to achieve ocean sustainability will greatly benefit from incorporating community perceptions and other social dimensions of the ocean. This study's exploration of social licence contributes to growing scholarly contribution from the marine social science community.

7

Final Discussion

7.1 Thesis overview

This thesis sought to document instances of social licence in the marine space, and demonstrated that social licence is an emergent concept in the marine realm, with considerable potential for application in a conservation context. The research was guided by an overarching aim to improve current understanding of social licence in a marine context, and sought to identify how social licence can be created and improved for marine activities and sustainable management into the future. Using primarily qualitative socioecological methods, the thesis revealed how theory and application of the concept of social licence can be developed to improve pubic engagement in, and support of, marine activities and management. Importantly, the thesis outcomes expand beyond the concept of social licence and contribute new theoretical and socioecological knowledge that can inform more active stakeholder engagement, relationship building, and the development of marine citizen science, amongst others.

The research documented in this thesis firstly collated and synthesised instances of social licence in the marine realm as documented in the literature, and revealed that social licence could be considered a 'tool' to encourage and foster public cooperation in sustainable marine management and development (Richert et al. 2015). It revealed three primary themes that delineated how social licence is applied and developed in the marine sector: marine management and conservation, aquaculture, and fisheries. The subsequent thesis chapters built on the dominant theme of marine management and conservation. For example, Chapter 3 outlined a need for marine conservation scientists to earn social licence, and identified how this requires a 'hands-on' approach (Lubchenco 2017). This chapter then elucidated steps for marine scientists to advocate for their research, to develop social licence for the ocean research that underpins marine conservation.

Social licence requires negotiating community expectations and values (Dare et al. 2014), however, prior to this thesis, little research had attempted to explore mechanisms for obtaining social licence (Moffat and Zhang 2014). Expanding upon the theme of marine management and conservation, chapters 4 and 5 investigated whether and how citizen science could inform the development of social licence for i) marine conservation, and ii) marine user groups. This research revealed novel linkages between social licence and citizen science (i.e. engagement, connecting stakeholders, legitimacy, stewardship) that were expanded upon to support marine conservation efforts, and a framework was constructed to outline how social licence could be achieved through marine citizen science in practice

(Figure 3). The research also demonstrated that citizen science can provide 'common ground' for diverse marine user groups to connect as citizen science participants, and to better perceive one another. Thus, also providing opportunity for these participants to enhance social licence for their respective groups and activities.

The final research case-study further built on the insights gained through the previous chapters, and applied social licence as a frame to investigate support and opposition for marine protected areas. The most important result of this component research was the revelation that social licence is not necessarily simplified as a support/oppose outcome, inferring a need for more nuanced understanding and dialogue around stakeholder engagement and perceptions of the ocean. These results were developed upon to generate another framework (Figure 5) that identified six stages in developing social licence for marine management in practice. Further, these outcomes suggested that marine conservation can benefit greatly from incorporating community perceptions, and developing meaningful engagement with stakeholders, to create dialogue that can improve and/or inform social licence.

This discussion chapter places the research findings of the component chapters described in context to one another and current literature findings. By identifying themes that have emerged through the development of the thesis, this discussion reflects on the novel insights of marine space social licence that have been produced through the case-study research components, and their implications. Following this, limitations of the thesis research are considered, and recommendations for future research and application of social licence are presented, with the aim to guide development and application of social licence in the marine realm and beyond.

7.2 Thesis implications

As highlighted above, the research chapters built upon one another to achieve the thesis objectives. This research produced novel understanding of social licence, and identified its potential for improving communication and engagement in sustainable ocean use and management. The qualitative insights gained through stakeholder interviews, questionnaire surveys and Q-method revealed how engagement, knowledge-sharing and perceptions of marine realm management (and marine user groups) could be improved through citizen science and other forms of active and meaningful engagement with stakeholders (e.g., Figure 5). Most importantly, the thesis research outlined how social licence can be used as an engagement tool to garner the community involvement and support

necessary to advise and achieve successful marine conservation worldwide. In addition, several shared themes were identified and developed to inform the expansion of the theory of social licence; including understanding perspectives, stakeholder engagement, citizen science and trust. These insights have potential to be applied and further developed in contexts beyond the marine, and in other conditions including community, policy, management and industry (e.g. the 'Blue Economy').

Recognising that marine stakeholders represent a diversity of world-views and values of the marine environment is crucial for understanding how and why particular management approaches do and do not work (Billing et al. 2017), and the qualitative insights garnered through the thesis investigations demonstrated a diversity of stakeholders and opinions present in the marine realm. Social science contributions play a crucial role in marine management and conservation (Smith 2002;Mascia et al. 2003) and the outcomes of this thesis have important connotations for management and policy practitioners seeking to create sustainable and socially-acceptable conservation and management strategies. In particular, by identifying stakeholder perceptions that can guide managers towards understanding the factors that motivate behaviour and/or the acceptance of management plans and outcomes (St. John et al. 2010), and through investigations of place- and context-based case-study investigations, that can inform the wider context (Leenhardt et al. 2015).

An ongoing challenge in marine management is combining social and natural science knowledge in truly interdisciplinary collaborations that can inform decision-making (Smith 2002;Mascia et al. 2003) and this thesis aimed to determine, and successfully outlined how social licence can potentially be applied in a transdisciplinary context (i.e. via citizen science, connecting stakeholders) to inform robust approaches to marine management. Applied socioecological research can also support the delivery of accountable and transparent decision-making and specifically, the case-study research identified shared perspectives as a means to provide space for stakeholders to develop dialogues and solutions that may have greater acceptance and social licence (Yates et al. 2019). Overall, the thesis emphasised a need to identify and understand stakeholder concerns and interests when working to build relationships, and highlighted the importance of context when seeking to obtain and develop social licence (Prno 2013;Hall and Jeanneret 2014). These results provide tangible information on the 'instrumental aspects of social licence' that can guide the formation and development of social licence in an industry context, particularly in regards to the Blue Economy (Voyer and van Leeuwen 2019)(p.104). For example, a business-industry view of social licence focuses on maintaining stakeholder support for industry activities (Hall and Jeanneret 2014), and the cyclical framework

(Figure 5) can be applied beyond the context of conservation management, to inform and guide industry, and other sectors, seeking to maintain their social licence.

This thesis was the first attempt to link social licence theory with citizen science, and outlined the potential for marine citizen science to enhance social licence for marine conservation. Stakeholder engagement is a key aspect of identifying and addressing challenges to social licence, and the thesis demonstrated the role that citizen science can play in improving active engagement with stakeholders. Importantly, trust was identified as a strong linkage between the concepts of citizen science and social licence, and the results presented in this thesis can advise those seeking to develop trust through citizen science (e.g., Gilfedder et al. 2019). These findings are likewise relevant to how social licence might be developed in other contexts, and present citizen science as a novel tool to explore in developing social licence in the context of marine management and conservation; particularly in reflecting on how citizen science can foster synergistic effects to improve engagement, ocean literacy, marine citizenship and trust.

Looking to the future, the thesis results provide valuable tools and insights that can be applied to guide programmes (in marine sector and other sectors) in their increasing attempts to position citizen science as an integral part of engagement between society, science and policy (Pecl et al. 2015;Hecker et al. 2018a). For example, the UN Decade of Ocean Science for Sustainable Development (https://en.unesco.org/ocean-decade) aims to achieve 'inclusive, participative and regionally driven' marine science, management and policy, and the EU Commission currently emphasises the role of citizen science in contributing to environmental policy, and improving public trust in such policy (EU 2018). The results of this thesis directly apply to how these aims can be effectively achieved in practice.

The thesis results also revealed that social licence is a highly nuanced concept that incorporates multiple perspectives and values, and the qualitative case-study investigations identified key components to achieving social licence; i.e. stakeholder engagement, co-operation, communication, dialogue and trust. It is expected that these components of social licence will become increasingly important for marine management and conservation, especially when considering the need to address human-dimensions of sustainable use of, and access to, the ocean. Qualitative investigations are valuable for descriptive, diagnostic and disruptive contributions to marine conservation and management (Bennett et al. 2017a), and in this thesis they:

- Revealed and described the myriad and diversity of stakeholder perceptions;

- Identified potential reasoning behind these perceptions (i.e. type of marine resource use, sense of place, access to information); and
- Re-shaped how stakeholder conflict and interactions are understood (i.e. views on marine protected areas are not dichotomous but rather, much more nuanced).

These qualitative insights challenged and examined how social licence can (or cannot) contribute to improving understanding and incorporating social dimensions in marine space dialogue, and can provide transformative insights into how sustainable and adaptive approaches to management might be achieved in practice. Thus, this thesis corroborates other research that has identified social licence as a tool for management (Boutilier et al. 2012). Further, the thesis improved current understanding of social licence in a marine context, and identified several means through which social licence can be developed and improved. However, it is likely that social licence will continue to change and evolve in multiple directions, and perhaps even beyond itself to emerge as a new theoretical construct and/or practical tool. Regardless of how social licence will develop into the future, the new knowledge and ideas produced in this thesis are enduring, in creating frameworks and pathways for active stakeholder engagement, building relationships, developing marine citizen science, and improving trust.

7.3 Limitations and future directions

This thesis arose from an iterative and reflective research process. The opening chapters of the thesis determined the research focus, by identifying themes of interest (i.e. marine conservation and management) that were developed upon in the research components of the following chapters. Every effort was made to design and conduct these research components to achieve accurate, valid and meaningful outcomes; however, research limitations remain an inherent part of any scientific investigation. For instance, the in-depth qualitative research revealed rich insights and evidence on complex topics, but the nature of this approach does not allow statistical generalisations to be generated. Findings from qualitative interviews are most often not generalisable in the same way that quantitative research intends to be. Further, qualitative interviews are inherently impossible to replicate, owing to the specific locational, temporal and social factors at play during each individual interview process (Edwards and Holland 2013).

Still, it is argued that qualitative social sciences can play a significant role in creating effective management and conservation strategies for conservation (Bennett et al. 2017b). Qualitative research approaches present many strengths, including providing opportunity to identify research participants'

perspectives, understandings and experiences, and to explore the significance of the meanings they generate (Edwards and Holland 2013). Interviews offer a flexible method that is useful for generating high quality data that provides in-depth understanding of complex topics and issues (Young et al. 2018), and colourful, in-depth information about the perspectives and experiences of individuals (DiCicco-Bloom and Crabtree 2006). These characteristics of qualitative interviews, in particular, affirm the suitability of using interviews in this thesis to investigate marine stakeholder perceptions and understandings in the context of social licence.

In this thesis, qualitative interviews were combined with quantitative questionnaire surveys to achieve a mixed-methods approach that revealed a more comprehensive understanding than could be provided using either quantitative or qualitative approaches alone (Creswell and Plano Clark 2011). The final case-study research component also adopted a mixed-method approach by combining the inherently mixed Q-method with qualitative interviews. Q-method centres around statistical (i.e. quantitative) analysis, but aims to achieve data with colour and depth that is more often associated with qualitative research (Brown 1990). This 'interactive qualitative-quantitative continuum' is apparent throughout the Q-method process (Ramlo 2015)(p.82), and the rich insights gained in applying Q-method in this thesis research provide in-depth understanding on the diversity and quantity of perceptions held by the participant sample (Ellis et al. 2007).

Another limitation that was unavoidable when executing the thesis research, was the focus on stakeholders and experiences in the modern western world. The research components conducted in Europe and Australia certainly provide insights that can be applied and expanded upon elsewhere, but it is likely that do not adequately account for experiences in lesser developed or affluent regions of the world (e.g. South East Asia, Sub-Saharan Africa, etc.). Furthermore, and regrettably, no Indigenous view was explicitly included in the research components described above. As explained in Chapter 6, attempts to garner Indigenous input proved difficult, owing to disparate western research and Indigenous culture worldviews. Future research endeavours could hopefully be more successful in this regard, and recognise the importance of including a wider diversity of values and priorities (Flannery et al. 2018). This future research could also attempt to combine quantitative and qualitative approaches through truly interdisciplinary research, that can better inform the development of the burgeoning socioecological approach (Kelly et al. 2019d). In doing so, it might be possible to obtain alternative perspectives that can more completely inform the potential for social licence to be applied as a tool for marine conservation globally.

7.4 Concluding remarks

This thesis determined that social licence is an emergent concept in the marine realm, and identified and demonstrated the potential for social licence to be used as a tool to improve public engagement and stewardship for marine conservation. Results obtained through the research investigations described in this thesis have important implications for the future development and application of social licence in a marine context. The core components of social licence (i.e. stakeholder engagement, dialogue and trust) will likely become increasingly important for marine management and conservation, especially when considering the urgency of managing our oceans sustainably in this rapidly changing world. It is likely that the concept of social licence will continue to change and evolve (perhaps even beyond itself), however the ideas explored and knowledge produced in this thesis are enduring, in terms of recognising pathways for active stakeholder engagement, building relationships and developing marine citizen science. Effective socioecological interdisciplinary research must be at forefront of identifying and developing solutions to the myriad challenges current marine management is charged with, and this thesis has advanced theoretical knowledge and the potential for social licence to be used as a tool that can improve the human dimensions of this management in practice.

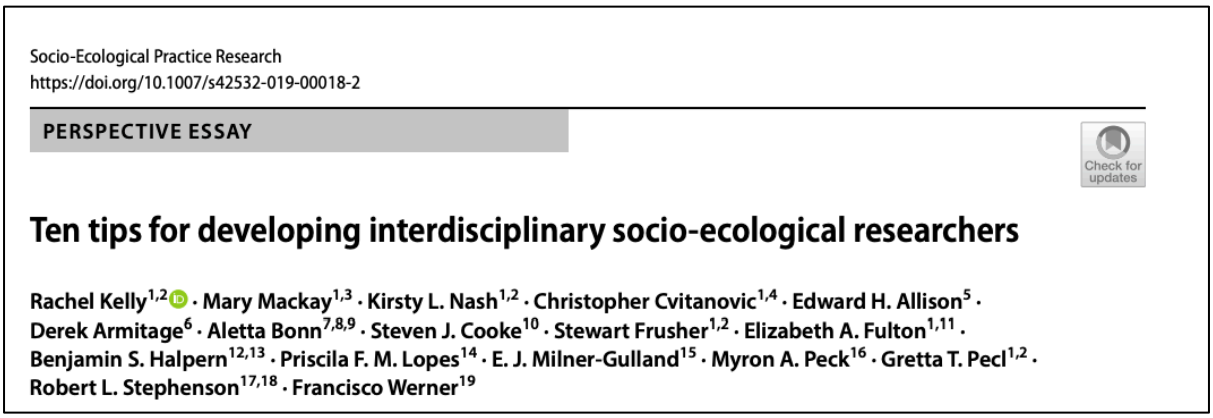
Appendices

Appendix A

Additional publications that I co-authored during my PhD candidature. These research papers contributed to the background thinking and conceptual development of this thesis (as outlined in the summaries below), but are not central to the thesis' focus on social licence in the marine realm.

1.

Kelly, R., M. Mackay, K. L. Nash, C. Cvitanovic, E. H. Allison, D. Armitage, A. Bonn, S. J. Cooke, S. Frusher, C. J. Fulton, B. S. Halpern, P. F. M. Lopes, E. J. Milner-Gulland, M. A. Peck, G. T. Pecl, R. L. Stephenson and F. Werner (2019). "Ten tips for developing interdisciplinary socio-ecological researchers." Socio-Ecological Practice Research. DOI: 10.007/s42532-019-00018-2.



Socio-Ecological Practice Research
https://doi.org/10.1007/s42532-019-00018-2

PERSPECTIVE ESSAY

Check for updates

Ten tips for developing interdisciplinary socio-ecological researchers

Rachel Kelly[1,2] · Mary Mackay[1,3] · Kirsty L. Nash[1,2] · Christopher Cvitanovic[1,4] · Edward H. Allison[5] · Derek Armitage[6] · Aletta Bonn[7,8,9] · Steven J. Cooke[10] · Stewart Frusher[1,2] · Elizabeth A. Fulton[1,11] · Benjamin S. Halpern[12,13] · Priscila F. M. Lopes[14] · E. J. Milner-Gulland[15] · Myron A. Peck[16] · Gretta T. Pecl[1,2] · Robert L. Stephenson[17,18] · Francisco Werner[19]

Summary of paper, my contribution, and relevance to this thesis

Interdisciplinary research and collaborations are essential to disentangle complex and wicked global socioecological challenges. Yet, institutional structures and practices to support interdisciplinary research are still developing and a shared understanding on how best to develop effective interdisciplinary researchers (particularly at early career stages) is lacking. I was the lead-author of this multi-author paper, of early career researchers and interdisciplinary 'experts', which collates and presents practical advice for those wishing to engage in interdisciplinary research. We (the four early career researchers) conducted interviews with the thirteen experts, and I conducted the qualitative analysis to generate results that aimed to improve understanding on how to conduct interdisciplinary research. This advice is presented in the form of '10 tips', to empower present and future generations of interdisciplinary researchers in their endeavour to solve contemporary socioecological challenges worldwide. The tips developed in this paper are highly relevant to effectively conducting the socioecological type research outlined in this thesis; specifically, in working across disciplines and appreciating new methodological approaches and theoretical positions.

2.

van Putten, E. I., C. Cvitanovic, E. A. Fulton, **R. Kelly** and J. Lacey (2018). "The emergence of social licence necessitates reforms in Environmental regulation." Ecology and Society **23**(3): 24. DOI: 10.5751/ES-10397-230324.

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Van Putten, I. E., C. Cvitanovic, E. Fulton, J. Lacey, and R. Kelly. 2018. The emergence of social licence necessitates reforms in environmental regulation. *Ecology and Society* 23(3):24. https://doi.org/10.5751/ES-10397-230324

Insight

The emergence of social licence necessitates reforms in environmental regulation

Ingrid E. van Putten [1,2], *Christopher Cvitanovic* [1,2], *Elizabeth Fulton* [1,2], *Justine Lacey* [3] *and Rachel Kelly* [2,4]

Summary of paper, my contribution, and relevance to this thesis

In this paper, we argue that increasing use of the social licence concept is an indication that trust in, and the legitimacy of, formal regulatory processes for natural resource management has eroded and needs to be reimagined. We outline five principles that provide pathways to increase the legitimacy of, and trust in, regulatory approval processes: (i) clear regulatory objectives; (ii) transparent regulatory approval processes; (iii) clear pathways for appeals and reviews of regulatory decisions (iv) early and inclusive collaborative consultation process; and (v) independence of decision-making authorities. My contribution to this paper included assisting in identifying illustrative examples of natural resource management experiences from Tasmania, as well as providing input to the discussion on the usefulness of social licence when formal processes and requirements no longer protect or represent community interests and expectations. Although this thesis focused on the concept of social licence in a marine context, the wider theoretical and practical utility of the concept remains contested. This paper offers an alternative lens through which to examine social licence (i.e. regulatory frameworks) that might be developed upon to work in parallel with the insights gained through this thesis (i.e. community-focused frameworks).

3.

van Putten, E. I., É. E. Plagányi, K. Booth, C. Cvitanovic, **R. Kelly**, A. E. Punt and S. A. Richards (2018). "A framework for incorporating sense of place into the management of marine systems." Ecology and Society **23**(4): 4. DOI: 10.5751/ES-10504-230404.

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Van Putten, I. E., É. E. Plagányi, K. Booth, C. Cvitanovic, R. Kelly, A. E. Punt, and S. A. Richards. 2018. A framework for incorporating sense of place into the management of marine systems. *Ecology and Society* 23(4):4. https://doi.org/10.5751/ES-10504-230404

Synthesis

A framework for incorporating sense of place into the management of marine systems

Ingrid E. van Putten[1,2], *Éva E. Plagányi*[2,3], *Kate Booth*[4], *Christopher Cvitanovic*[1,2], *Rachel Kelly*[2,5], *Andre E. Punt*[1,6] *and* *Shane A. Richards*[1]

Summary of paper, my contribution, and relevance to this thesis

To date, marine research and management have largely neglected the critically important role of "sense of place" and its role in influencing the success and efficacy of management interventions. In this paper, we aimed to help address this gap by reviewing the existing literature from various disciplines (e.g., environmental psychology) and sectors (both marine and nonmarine) to understand the ways in which sense of place has been conceptualised and measured. We drew on three key aspects of sense of place - person, place, and process - to establish a framework to help construct a more organised and consistent approach for considering and representing sense of place in marine environmental studies. This paper is a 'first step' toward increasing the extent to which sense of place is incorporated into modelling, monitoring, and management decisions in the marine realm. My contribution to this very useful review paper included identifying, reading and reviewing the relevant literature, particularly in regards to the history and development of this concept. The subject theme of this paper is relevant to how marine communities and stakeholders can relate to, and engage with, the marine environment. Thus, it is germane to how social licence can be explored and developed in practice; in particular, exploring the context and results of chapters 4,5 and 6.

4.

Cvitanovic, C., E. I. van Putten, A. J. Hobday, M. Mackay, **R. Kelly**, J. McDonald, K. Waples and P. Barnes (2018). "Building trust among marine protected area managers and community members through scientific research: Insights from the Ningaloo Marine Park, Australia." Marine Policy **93**: 195-206. DOI: 10.1016/j.marpol.2018.04.010.

Marine Policy 93 (2018) 195–206

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Building trust among marine protected area managers and community members through scientific research: Insights from the Ningaloo Marine Park, Australia

C. Cvitanovic[a,*], E.I. van Putten[a,b], A.J. Hobday[a,b], M. Mackay[a,c], R. Kelly[a,d], J. McDonald[a,e], K. Waples[f,g], P. Barnes[h]

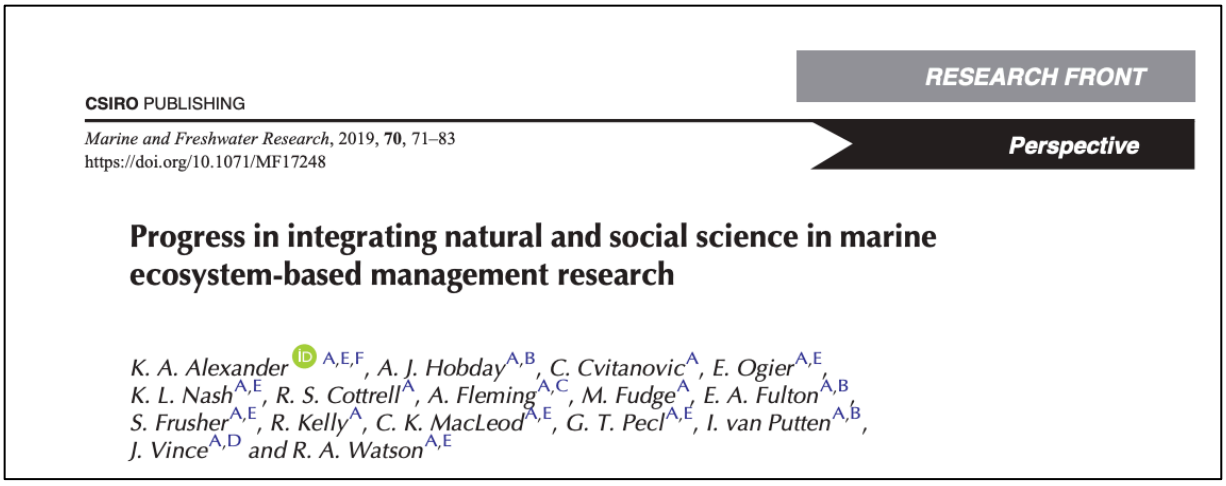
[a] Centre for Marine Socioecology, University of Tasmania, Battery Point, Tasmania 7004, Australia
[b] Oceans and Atmosphere, CSIRO, Hobart, Tasmania 7001, Australia
[c] Tasmanian School of Business and Economics, University of Tasmania, Sandy Bay, Tasmania 7004, Australia
[d] Institute for Marine and Antarctic Studies, University of Tasmania, Battery Point, Tasmania 7004, Australia
[e] Faculty of Law, University of Tasmania, Sandy Bay, Tasmania 7004, Australia
[f] Marine Science Program, Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia, Australia
[g] Western Australian Marine Science Institution, Crawley, Western Australia, Australia
[h] Department of Biodiversity, Conservation and Attractions, Exmouth, Western Australia, Australia

Summary of paper, my contribution, and relevance to this thesis

This study aimed to understand the extent to which scientific research programs can enhance trust among marine protected area (MPA) managers and community members, via an evaluation of the Ningaloo Research Program (a large-scale marine research programme in the Ningaloo Marine Park, Western Australia). Our results showed that community members along the Ningaloo coast believe that scientific research is important for the management of the marine park, and strongly support government investment in scientific research in the region. The results also suggest that science undertaken through the Ningaloo Research Program has increased the extent to which community members trust local managers, which study participants believe has led to improved social and environmental outcomes in the region. My contribution to this project included conducting surveys of community members in Ningaloo in 2017, contributing to the analysis of this data, and identifying opportunities to maintain and further enhance trust between community members and MPA managers, e.g., the establishment of citizen science programmes in the region. The investigations and results of this thesis, particularly in regards to citizen science, are exactly aligned to providing opportunities for communities to engage with science and managers, as called for in this paper.

5.

Alexander, K. A., A. J. Hobday, C. Cvitanovic, E. Ogier, K. Nash, R. S. Cottrell, A. Fleming, M. Fudge, E. A. Fulton, S. Frusher, **R. Kelly**, C. Macleod, G. T. Pecl, E. I. van Putten, J. Vince and R. A. Watson (2018). "Progress in integrating natural and social science in marine ecosystem-based management research." Marine and Freshwater Research **70**(1): 71-83. DOI: 10.1071/MF17248.



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Perspective

Progress in integrating natural and social science in marine ecosystem-based management research

K. A. Alexander A,E,F, *A. J. Hobday*A,B, *C. Cvitanovic*A, *E. Ogier*A,E, *K. L. Nash*A,E, *R. S. Cottrell*A, *A. Fleming*A,C, *M. Fudge*A, *E. A. Fulton*A,B, *S. Frusher*A,E, *R. Kelly*A, *C. K. MacLeod*A,E, *G. T. Pecl*A,E, *I. van Putten*A,B, *J. Vince*A,D and *R. A. Watson*A,E

Summary of paper, my contribution, and relevance to this thesis

Development and operationalisation of ecosystem-based management in the marine environment has been slow to date. One reason for this, may be a lack of the interdisciplinary science required to address complex socioecological marine systems. In this paper, the authors' collective experience was synthesised to explore progress in integrating natural and social sciences in marine ecosystem-based management research, and to illustrate actual and potential contributions. My contribution to this paper project included identifying informal barriers to, and incentives for, interdisciplinary marine research. In particular, how best to support students and early career researchers undertaking interdisciplinary research that aims to inform and operationalise marine ecosystem-based management. In the development of this thesis, I have followed many of the recommendations made in this paper, including:

i. exploring the important role of effective marine science communication;
ii. improving understanding on interactions occurring in the socioecological (i.e. through a thorough examination of the concept of social licence); and
iii. detailing my research methodologies and results in a format that can be understood across disciplines and sectors.

Appendix B

Chapter 4 survey and interview questions

1. Survey questions

Thank you for following the link to this survey!

Successful marine environmental management addresses the **needs and interests of stakeholders and communities.** We are researchers interested in the perceptions and opinions of Marine Citizen Science coordinators and participants in European projects. Our study investigates whether Marine Citizen Science promotes public understanding of marine environmental issues and whether this promotes public support and acceptance for current marine management in the EU.

Our project builds upon data collected by the **European Marine Board** and seeks to address some of the necessary conservation actions it has identified (see http://marineboard.eu/publication/advancing-citizen-science-coastal-and-ocean-research-position-paper). This survey is also part of the ECOPOTENTIAL research project (http://www.ecopotential-project.eu/). We will conduct surveys of Citizen Science co-ordinators and participants from marine projects in the EU to advise this data. Following this, we will conduct selected interviews with several coordinators and participants. The summarised and anonymised information we collect will be made available to all participants and Marine Citizen Science projects that take part in the study, as well as the European Marine Board's Working Group. The data will not be passed onto other persons or groups. Data will be saved for 5 years, and after this period all data will be deleted.

This survey component will take approx. 10 minutes to complete. It asks questions on 1) your Marine Citizen Science project, and your opinions on 2) participant engagement and perceptions, 3) marine management in Europe. Participation in the survey is voluntary. You are free to withdraw from this survey at any stage, your personal details will remain confidential.

If you wish to conduct this survey in a language other than English, please email X

Thank you very much in advance for taking part in this survey.

Survey for Marine Citizen Science Coordinators

☐ I agree to conduct this survey, that my answers will remain anonymous, and that the survey results may be published to inform understanding and development of Marine Citizen Science in Europe. This consent can be revoked at any time.

1. Which Marine Citizen Science project do you coordinate/participate in?
   Name: _____ Weblink: _____
2. What are your responsibilities in this role? *Please tick all that apply.*
   a. I coordinate participants and project activities
   b. I manage the data we collect in the project
   c. I engage with the participants on outreach and education
   d. I teach/organise science for the project
   e. Other, please identify: _____

3. In what year (approx.) was your Marine Citizen Science project established? _____
    a. Approx. how many participants does your project engage with? _____
    b. Approx. how many of these participants are **active** within the project? _____

4. Does your project actively engage and educate participants on these issues? *Please tick all that apply.*
    a. Biodiversity (i.e. species, habitats)
    b. Ecosystem services (i.e. recreation)
    c. Climate change
    d. Marine regulation (i.e. fisheries)
    e. Marine conservation in general (i.e. protection, regulation)
    f. European level marine conservation/management
    g. State/National level marine conservation/management
    h. Other

    It is important for us to understand **how** your project engages and educates participants on these issues. Can you please provide some detail?

    _____

5. Do you think that participation in Marine Citizen Science increases participant's general understanding of:
    a. The marine environment?
    A lot … Not at all (Likert) / Don't know. Can you provide any evidence for this from your project? _____
    b. Marine conservation?
    A lot … Not at all (Likert) / Don't know. Can you provide any evidence for this from your project? _____

6. Do you think that participation in Marine Citizen Science increases participant's general support for marine conservation and regulation? *A lot … Not at all (Likert) / Don't know*
    It is important for us to understand **how Citizen Science increases support,** please explain _____

7. Do you think that participants in your Marine Citizen Science Project trust EU government to manage European marine environments and resources? *Trust a lot / A little / Neutral / Somewhat / Do not trust at all (Likert)*

8. Do you trust EU government to manage European marine environments and resources? *Trust a lot / A little / Neutral / Somewhat / Do not trust at all (Likert)*

9. Do you think your country's government manages its marine environment and resources (i.e. fisheries, etc.) well? *Extremely well / Very well / Okay / Badly / Very badly*
    a. Do you think that your country's government manages its marine environment and resources in accordance to EU regulations? *Extremely well / Very well / Okay / Badly / Very badly / Don't know*

10. In your opinion, do you think that participants in your Marine Citizen Science project are **more likely to support marine regulation and conservation**, than:
    a. before they engaged with Citizen Science?
    Less likely / more likely / likely / about the same / less likely / least likely
    b. people who do not engage with Citizen Science?
    Less likely / more likely / likely / about the same / less likely / least likely

11. Do you think Citizen Science can work to influence marine policy and management in Europe? *Yes / No / Don't know*
    How? _____

12. Male / Female / Prefer not to specify
13. Age
    a. Under 18
    b. 18-25
    c. 26-35
    d. 36-45
    e. 46-55
    f. 55-64
    g. 65+

14. Job title _____
    Name of Organisation _____

15. We value your opinion and support very much. If you have any additional information, comments or further contacts you think we should approach please let us know here:

16. How easy did you find this survey? *(Likert)*

17. Would you like to receive a summary of the results via email? *Please provide your:*
    Name _____
    Email address _____

Thank you very much for conducting this survey.
We are grateful for your time and expertise!

2. Interview questions

Their Citizen Science project

1. Can you tell me a bit about your project? *Size, research, history, who runs it, funding?*

2. What is the main purpose (focus/benefit) of your project?
   For my own info, to 'tick off' when they answer:
   - *Collecting data and producing new knowledge for science*
   - *Providing data that marine managers and policy-makers can use*
   - *Educating the public about marine issues and science (and creating environmental behavioural change)*
   - *Benefiting nature, by learning about it (and protecting it)*

3. How does your project interact with its participants*? Internet, meet-ups, newsletters, education sessions, programme training, etc.*

Citizen Science more generally

4. What does 'citizen science' mean for you?
   Do you think others would agree? Are there other meanings you agree/disagree with?
   (Do you think your project is 'citizen science'?)

5. Do you see a role for citizen science to inform the public about marine conservation and protection?
   How could it be used to promote such communication and exchange?
   Has your citizen science project informed (taught) participants about marine conservation?
   Increased awareness? Changed opinions? How?

Marine Citizen Science in Europe

6. Do you think citizen science can influence marine conservation and management in Europe? *How? At what scale (temporal, spatial)?* (adapted from Vann-Sander et al. 2016)

7. Do you think the awareness that citizen science creates about marine issues can promote greater trust in marine conservation and management? *(Clarify) Compared to those who don't participate in citizen science? How? Can you give any examples?*

8. Apart from the usual expectations of public awareness, education and data collection, do you think citizen science could be used a tool in other ways for marine conservation? (adapted from Vann-Sander et al. 2016)

Social Licence

9. Have you heard about social licence?
   (Define it here – 'ongoing approval or broad social acceptance')
   Where? In what context? What does 'social licence' mean to you?
   Do you think social licence actually occurs? Where? For which groups? Local, regional, national? Can you give any examples?

10. **Do you think marine citizen science programmes can influence social licence for marine conservation and protection in Europe?**
    (Explain question) *In what ways? Through what processes? Can you give any examples?*

Closing thank you. Ask for anything I might have missed in my questions, any other information they'd like to give or think is useful.

Appendix C

List of 34 projects sampled in survey phase of Chapter 4

	Project Name	Country	URL	Year established	No of participants	Active participants	Biodiversity	Ecosystem Service	Climate Change	Marine regulation	Marine conservation in gen	European level marine conservation/management	State level marine conservation/management	Other	Do you think CS can influen marine policy and management in Europe?
1	MyOSD	Germany	www.my-osd.org	2014	1400	1400	1	0	0	0	1	0	0	Marine microbes	Yes
2	Planktonid	Germany	https://planktonid.geomar.de	2016	1000	320	1	0	1	0	0	0	0	Biogeoche mical fluxes	Yes
3	OpenLitterMap	Ireland	https://openlittermap.com	2015	200	5-10	0	0	0	0	0	0	0	Plastic pollution from land	Yes
4	Citclops	Spain	http://www.citclops.eu/		3000	300	1	1	0	1	1	0	0		Yes
5	Citizen Science for CIGESMED	Mediterranean	http://cs.cigesmed.eu	2015	150	30	1	1	1	0	1	1	1		Yes
6	Capturing Our Coast	UK	capturingourcoast.co.uk	2015	4000	300	1	0	1	0	1	0	0		Yes
7	Capturing Our Coast	UK	capturingourcoast.co.uk	2015	5000	2500	1	1	1	0	0	0	0		Yes
8	Capturing our Coast	UK	capturingourcoast.co.uk	2015		2000	1	0	1	0	1	0	0		Yes
9	Capturing our Coast	UK	capturingourcoast.co.uk	2015	2300	400	1	0	1	0	1	0	0		Yes
10	Capturing Our Coast (South West)	UK	capturingourcoast.co.uk	2015	4328	2271	1	0	1	0	1	0	0		Yes
11	Capturing our Coast	UK	capturingourcoast.co.uk	2015	3000	1000	1	1	1	0	1	0	0		Yes
12	Capturing Our Coast	UK	capturingourcoast.co.uk	2015	3000	500	1	1	1	0	1	0	0		Yes
13	Waves of Waste	UK	http://www.ywt.org.uk/waves-waste	2008	50 +	23	1	0	0	0	1	0	0	Marine pollution	Yes
14	SeaWatchers	Spain	http://www.seawatchers.org/	2012	3000	800	1	0	1	0	1	0	0		Yes
15	British Seahorse Survey	UK	www.theseahorsetrust.org	1994	5000	varies	1	1	0	1	1	1	1		Yes
16	APHOTOMARINE	UK	www.aphotomarine.com	2006	unk.	unk.	1	0	0	0	0	0	0	Non-native species	Yes
17	Shark Trust	UK	www.sharktrust.org/anglers	2009	250	>10%	1	1	0	1	1	0	1		Yes
18	PlanktonID	Germany	https://planktonid.geomar.de	2017	332	50	1	0	0	0	0	0	0		Yes
19	iSeahorse	EU-wide	www.iSeahorse.org	2013	475	100	1	0	0	0	1	0	0		Yes
20	Secchi Disk study	UK	www.secchidisk.org	2013	2000	2000	0	0	1	0	1	0	0	Global issues	Yes
21	UK National Marine Mammal Monitoring	UK	http://www.seawatchfoundation.ac.uk	1976	3,000	2,000	1	1	1	1	1	1	1		Yes
22	Seasearch	UK	www.seasearch.org.uk	1998	200/yr	400/yr	1	0	1	1	1	1	1		Yes
23	Big Seaweed Search	UK	www.nhm.ac.uk/seaweeds	2009	500	250	1	0	1	0	1	0	0		Yes
24	Beach Explorer	Germany	www.beachexplorer.org	2014	10000	1000	1	0	0	0	1	0	0		Yes
25	ORCA Marine Mammal Surveyors	UK	orcaweb.org.uk	2006	800	500	1	0	0	0	1	1	1		Yes
26	One Ocean Forum	Italy	https://www.oneoceanforum.org/en/	2017			0	1	1	0	1	0	1		Yes
27	The Shore Thing	UK	www.mba.ac.uk/shore_thing	2006	5000+	<1000	1	0	1	0	1	0	0		Yes
28	Sealife Survey	Ireland	http://www.mba.ac.uk/recording/	2005	1300	540	1	0	0	0	0	0	0		Yes
29	Emmett Johnston	Ireland	www.baskingshark.ie	2009	10-50	10	1	0	0	1	1	1	1		Yes
30	VBRANT	EU-wide	www.vbrant.eu	2010	15	4	1	1	1	1	1	1	1		Yes
31	The Big Jellyfish Hunt	Ireland	https://www.facebook.com/ecojel/?ref=bookmarks	2009	2300	100's	1	0	0	0	0	1	0	Jellyfish diversity	Yes
32	Great Eggcase Hunt	UK	www.sharktrust.org/eggcase	2003	>3000	>3000	1	0	0	0	1	0	1		Yes
33	Spot the Jellyfish (& Spot the Alien Fish)	Malta	www.ioikids.net/jellyfish; (www.aliensmalta.eu)	2010 (2017)	1000-2000	100-200	1	0	1	0	1	0	1		Yes
34	Dive Into Science	UK	www.diveintoscience.org	2015	7000 dives	unk.	0	0	1	1	1	0	0		Yes

Appendix D

Chapter 5 survey and interview questions

1. Survey questions

Demographics

18. Male/female
19. Age
20. Education
    a. *Year 10*
    b. *Year 12*
    c. *Certificate Dip/Ed*
    d. *Bachelor Degree*
    e. *Advanced degree (e.g. Masters, PhD)*
21. Highest level of education in science?
    a. *Studied science after high school*
    b. *Elective/specific high school science subjects*
    c. *Compulsory/general high school subjects*
    d. *Only studied science at primary school*
    e. *Never studied science*
22. Location (by state)
23. Do you identify yourself as: 'fisher' / 'diver' / 'boater' / 'other'? *Option to select primary, then multiple responses.*
24. For each:
    a. How long have you been, e.g. a fisher?
    b. Where? *Locally / nationally / internationally?*
    c. Are you a member of a club in your region? *How many?*

Social Capital / Networks

25. How long have you lived in the area you live now?
    a. *Lifelong*
    b. *20+ years*
    c. *5-20 years*
    d. *1-5 years*
    e. *Less than one year*
26. Do you fish/dive/boat in your local area?
27. Do you participate in other local activities clubs? *If yes, identify.*
28. How active do you consider yourself involve in local community activities?
    a. *Extremely*
    b. *Very*
    c. *Somewhat*
    d. *Occasionally*
    e. *Not at all active*
29. Do any of your family members participate in local activities or clubs?

Redmap

30. How did you hear about Redmap?
    a. *Friend*
    b. *Family member*
    c. *Local club*
    d. *Online*
    e. *Other*
31. Are you a follower of Redmap Facebook, Twitter, newsletter, etc.? *(Tick boxes)*
32. How long have you followed Redmap on social media, etc.?

33. Have you ever logged a sighting on the Redmap website? *If yes, how many times?*
34. Have you ever recommended Redmap to someone else?
    a. *Friend*
    b. *Family member*
    c. *Club member*
    d. *Online post*
35. Do you find Redmap social media educational? *Fishing / CC / ocean / other*
    a. *If yes, What? Have you shared this knowledge with others?*
36. Does your involvement in Redmap increase your interaction with other groups, i.e. fishers? *Yes/no, identify*

Final section

37. How well do you think Australia manages its marine resources (i.e. marine environment, fisheries, etc.) sustainably? *Extremely well / Very well / Okay / Badly / Very badly*
38. In your opinion, do you think Australians are concerned with marine sustainability?
39. Has engagement with Redmap increased your interest in marine sustainability?
40. In your opinion, are people who engage with Redmap generally concerned with marine sustainability?
41. Comments

2. Interview Questions

Opening hello

Identification

1. Do you consider yourself a fisher, diver or boater (or multiple of these)?
    a. *How often do you fish, dive, etc.?*
    b. *Alone, with friends, in a club?*
2. In your experience, who are the main marine space users in Australia?

Redmap (for Redmap participants only) *

3. What are your opinions of Redmap as a participatory citizen science programme?
4. Are you currently involved or do you participate in (interact with) Redmap? *If yes, how?*
    a. B*ased on your own experiences who do you think the main user groups of Redmap are?*
    b. *Do they communicate? How?*
    c. *Are the groups within Redmap distinct? Why?*
    d. *Do you feel that there a majority user group in Redmap? Who?*
5. In your experience, is Redmap a platform on which you can communicate with different ocean user groups (i.e. recreational fishers)?
    a. *Online, in person?*
    b. *Has it changed your opinion of these other groups (i.e. recreational fishers)?*
6. Does Redmap social media influence your opinions about other marine user groups (recreational fishers)?
    a. *How? Which groups?*
    b. *In your opinion, does Redmap promote all marine user groups equally?*
7. How would you envisage Redmap being used to promote communication and exchange between different user groups?

Social licence

8. Have you heard about SLO? **Define it here – ongoing approval or broad social acceptance…'*
    a. *Where?*
    b. *In what context?*

    c. *What does 'SLO' mean to you?*
9. Do you think SLO actually occurs?
    a. *Where?*
    b. *For which groups? For management? Local, regional, national?*
10. Do you think that SLO is influential in decisions made about marine space use or regulation?
11. Do you think Redmap (as a participatory citizen science programme) can influence SLO? (Explain question)
    a. *In what ways? Through what processes? (Who?)*
    b. *In which industries/spaces?*
12. Has your participation in Redmap changed your perspective of other groups (i.e. SLO to recreational fishing)?

<u>*For non-Redmap interviewees</u>

13. Do you interact with other users of the marine space (divers, boaters, fishers, etc.)? *If yes, how?*
14. Based on your own experiences, do you think the different user groups interact?
    e. *Do they communicate? How?*
    f. *Do you feel that there a majority marine user group? Who?*
15. Would you like to have opportunities to communicate with different ocean user groups (i.e. recreational fishers)?
16. What influences your opinions about other marine user groups (recreational fishers)? *i.e. social media, local media, community networks, personal experiences?*
    a. *How? Which groups?*
17. Would you like to increase communication and exchange between different user groups? *i.e. citizen science, local meet-ups, social events, etc. How?*
18. Have you heard about the programme Redmap (citizen science)? *Are you interested in participating?* (useful to differentiate)

<u>Closing thank you.</u>

Appendix E

Chapter 6 detailed description of Q-methodology and analysis, including Q-statements and matrix.

1. Q-method

In Q-method, participants (the P-set) are asked to rank a set of statements (the Q-sample), according to how they agree or disagree with those statements. This ranking process is called a 'Q-sort', and the statements used (the Q-sample) must be something that the P-set are likely to hold an opinion on (Webler et al. 2009). Interviews are a useful source from which to derive a concourse because the Q-sample is drawn directly from the stakeholder groups being studied. In this study, interviews provided history and context for the contemporary case-study we investigated. A concourse (i.e. a set of discourse in conversation, media and/or text around an issue) of 56 statements was constructed based on quotations from transcripts of interviews with key Tasmanian marine stakeholders (i.e. managers, fisheries representatives, recreational divers, commercial operators, etc.) undertaken in 2014-15 by CG (see (García 2017). These historic interview transcripts were coded using the qualitative analysis software NVivo 11.4.3 (QSR International, Melbourne, Australia) and resulting codes (i.e. *marine values, stakeholders, MPAs support/opposition,* and *politics)* were used as themes under which to derive the final Q-sample (n = 33).

The aim of identifying a P-set is to capture the range of opinions represented within the concourse, and typically, one to three dozen participants are expected to be sufficient (Webler et al. 2009). In addition, participants should be selected for comprehensiveness and diversity, as opposed to representativeness or quantity (Eden et al. 2005). The P-set in this study (n = 21) were strategically selected from marine user and management communities in Tasmania, based on their knowledge and background in Tasmanian marine environmental affairs, and most were in leadership roles. The research team verified and piloted the Q-sort together, and the stakeholder Q-sorts were all conducted in person by the lead author (except one, conducted by MM) in Tasmania, in April 2019. Each of the P-set sorted the Q statements onto a fixed matrix (with a ranking scale of -4 to 4) according to whether each statement was, for them, 'most like how I think' or 'least how I think'. These Q-sorts lasted between 20-30 minutes and in each case, were followed by a semi-structured interview. Human ethics approval for this research was authorised by the University of Tasmania, Australia (2019 ref: H0017840; CG interviews ref: H0014037).

2. Q-method analysis

In Q factor analysis, correlations between participants, as opposed to variables, are factored. Thus, it identifies which sets of stakeholders 'cluster together' on a particular issue (Du Plessis 2005). In this

study, the Q-method analysis software PQMethod (*Release2.35 with PQROT 2.0*) was used to calculate a correlation matrix of all the Q-sorts. Each Q-sort was correlated with every other Q-sort, and their intercorrelation matrix was factor analysed, then principal component analysis was conducted to group the individual perspectives. The sorts that loaded significantly on each factor were then 'flagged', as they were indicative of the perspective, when the following condition applied:

$$q \geq = \frac{2.58}{\sqrt{N}} = \frac{2.58}{\sqrt{33}} = \pm 0.449$$

where N = the number of statements (33).

The number of factors was determined using the Kaiser-Guttman criterion, i.e. selecting unrotated factors with eigenvalues greater than one (Brown 1990). Six factors satisfied this criterion and were plotted (i.e. Cattell Scree Test) to identify and justify the number of potential factors used (Fig. 2). Factors to the left of the plateau in Figure X were recommended for rotation (i.e. 1, 2 or 3 factors), as they explained the majority of the data without resulting in confounding perspectives. Following this, the programme was used to rotate these identified factors using the 'QVARIMAX' command, and to output the final analysis.

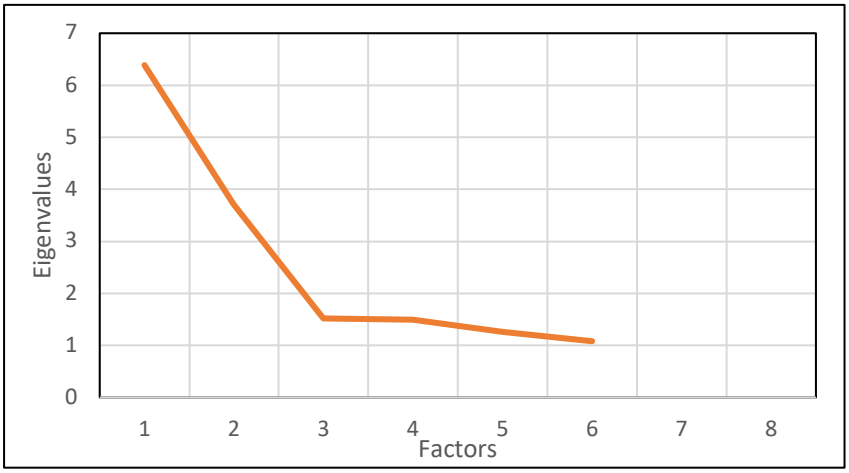


Figure X. Results of Cattell Scree Test revealed that up to six factors could be considered, but that three or fewer were recommended for rotation.

The Cattell Scree test determined that three-factor rotation was possible (Fig.2), however further comparison revealed that three-factor rotation did not capture distinct perspectives, or adequately account for variance; a third of sorts loaded on two factors (n=7), and there was 60% correlation between factors 1 and 3. Thus, two-factor rotation was identified as the optimal number of factors. This rotation accounted for 48% of the explained variance, and the number of confounding sorts

decreased to three. The two factors representing the social perspectives of the marine stakeholders are elucidated below, using stakeholder quotations (de-identified by codes) to present the views for those who loaded significantly on each perspective and identify commonalities between perspectives.

3. Q-statements

Values

1. Tasmania's marine environment is unique and diverse.
2. Tasmania's marine environment provides local jobs.
3. The ocean is an important source of food.
4. Having access to the ocean is important to me.
5. I would choose to protect the ocean.
6. The ocean is culturally important in Tasmania.

Stakeholders

7. As a marine stakeholder, I feel included in decision-making processes.
8. I'd like the opportunity to interact with other stakeholder groups to discuss marine issues together.
9. In Tasmania, people are afraid to be in one camp or the other (pro-conservation or anti-conservation) and it's often hard to find a middle ground.
10. MPAs might have detrimental effects on commercial fisheries in Tasmania.
11. The conservation groups in Tasmanian are definitely pro-MPAs.
12. Conservation organisations don't have much political influence in Tasmania.
13. Commercial fishers are very influential because the industry is worth a hell of a lot of money.
14. Recreational fishers are important stakeholders because they represent a lot of voters.
15. There is a vocal minority who has a particular view, and they don't mind telling you what their views are.

MPA support/opposition

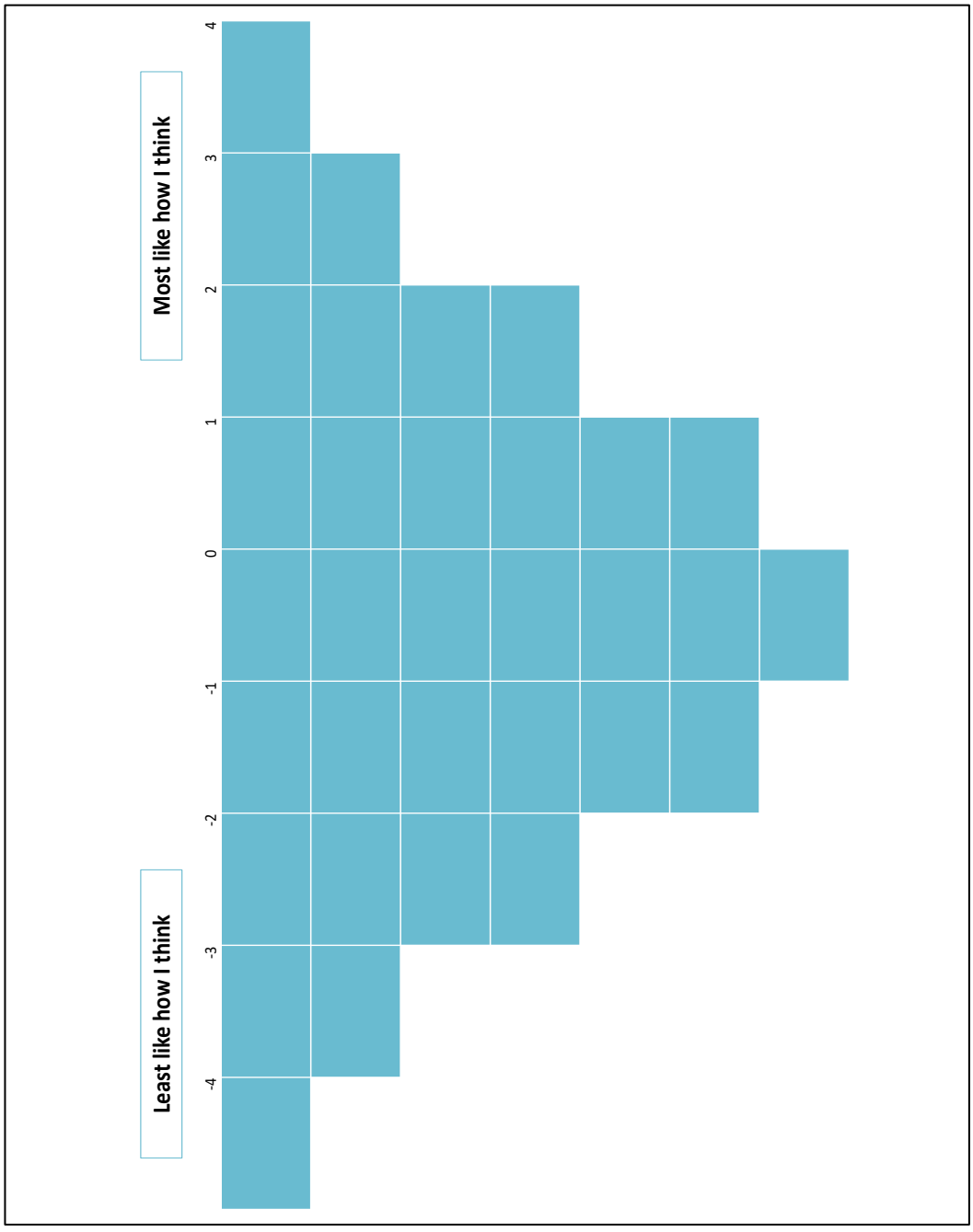
16. Tasmania's MPA system is pathetic, it's one of the worst systems in the world.
17. We need to think about protecting Tassie's marine environment in MPAs for the future.
18. MPAs are absolutely critical to protect the functioning and health of the marine environment.
19. The marine environment is out of sight and mind, a lot of people don't actually understand it.
20. We need no-take MPAs in Tasmania.
21. It's hard to know what people think about MPAs.
22. MPAs are not the only strategy for marine environmental protection.
23. MPA management is about people and their relationships.
24. I look to my peers to understand their views on MPAs.

Political climate

25. Conservation issues in Tasmania are highly politicised.
26. Plans to establish new MPAs will continue to be problematic for the Tasmanian government.
27. After the problems with the forests, people don't want another conservation problem with MPAs.
28. It's very difficult to achieve real conservation outcomes for resource management in Tasmania.
29. Tasmanian MPAs don't have buy-in (or social licence) from the fishing industry.

30. The government don't support marine conservation.
31. Tasmanian politicians don't want to lose votes so they've banned MPAs.
32. A lot of Tasmanian politics occurs behind closed doors, we don't actually know what is discussed.
33. The media have created political divides in Tasmania.

4. Matrix design



Appendix F

Chapter 6 interview questions

Opening hello

1. What is your understanding of MPAs?
2. What is your opinion about MPAs in Tasmania?
3. *What are the main factors that shape your position (why)?*
   What do you think about the current MPA system in Tasmania (state waters)?

4. Do you think that MPAs are controversial (in Tasmania)?
   If so, why?

5. Do you think MPAs in Tasmania have social licence*?
   How do you define social licence*?
   (**Define 'social licence' earlier if interviewee is not familiar with the term).*

6. What organisations or stakeholder groups, do you think, shape social licence for MPAs in Tasmania?
   Do you think that these organisations/groups represent the wider community views?

7. Do you think that social licence for MPAs in Tasmania is increasing or decreasing (trending), or neither?

8. Do you think the status of social licence for MPAs in Tasmania has changed since the government issued a ban on new MPAs in 2014?
   Why/why not? Has your position/opinion changed?

8. Do you think that social licence for MPAs in Tasmania could be improved?
   Do you think it should be? How? When? By whom?

9. Is there anything else you would like to add, or discuss around this conversation of social licence for MPAs in Tasmania?

Closing thank you. Ask for anything I might have missed in my questions, any other information they'd like to give or think is useful.

Appendix G

PDFs of the four chapters in this thesis that have been published in peer reviewed journals, as:

1.

Kelly, R., G. T. Pecl and A. Fleming (2017). "Social licence in the marine sector: A review of understanding and application." Marine Policy **81**: 21-28. DOI: 10.1016/j.marpol.2017.03.005.

2.

Kelly, R., A. Fleming and G. T. Pecl (2018). "Social licence for marine conservation science." Frontiers in Marine Science **5** 414. DOI: 10.3389/fmars.2018.00414.

3.

Kelly, R., A. Fleming, G. T. Pecl, A. Richter and A. Bonn (2019). "Social license through citizen science: A tool for marine conservation." Ecology and Society **21**(1):16. DOI: 10.5751/ES-10704-240116.

4.

Kelly, R., A. Fleming, G. T. Pecl (2019). "Citizen science and social licence: Improving perceptions and connecting marine user groups." Ocean and Coastal Management **21**(1):16. DOI: 10.1016/j.ocecoaman.2019.104855.

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Social licence in the marine sector: A review of understanding and application

Rachel Kelly[a,b,*], Gretta T. Pecl[a,b], Aysha Fleming[b,c]

[a] Institute for Marine & Antarctic Studies, Hobart, Tasmania 7001, Australia
[b] Centre for Marine Socioecology, University of Tasmania, Hobart, Tasmania 7005, Australia
[c] CSIRO, Salamanca, Hobart, Tasmania 7001, Australia

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ABSTRACT

Our global oceans are threatened by climate change, overfishing, pollution and a growing list of other impacts that demonstrate an urgent global need for sustainable ocean management. Whilst marine conservation initiatives and protected ocean spaces have increased over recent years, ocean management still lags behind the terrestrial sectors in incorporating and involving communities in its development. 'Social licence to operate' is used broadly across the terrestrial literature, but its understanding and application within the marine has been limited to date. This review sought to collate and synthesise instances of social licence in the marine realm as documented in the literature, aiming to create an understanding that may inform future research and development of social licence. Its results determine that social licence is yet an emergent concept in the marine sector but there may be great potential for its application in the marine context. Social licence has become an important theme for development in marine industry and resource use, particularly towards exploring communication and stakeholder engagement. This paper identifies future themes and areas requiring investigation and application in this domain.

1. Introduction

Declining marine biodiversity and the increasing effects of human population growth and climate change on the oceans are gaining public attention worldwide [30]. As consumers become more affluent and communities more informed, expectation for sustainability and sustainable practices are fast becoming 'the norm' and communities are pushing for transparency and more involvement in decision making processes [23,55]. With increasing demand for natural resources, a concomitant positive trend towards engagement and partnership with users and citizens is emerging, and global discussion on citizen involvement in policy and decision-making processes is growing [5]. Stakeholder involvement has been demonstrated to improve the rigour and strength of decisions made, as well as the capacity of relationships amongst diverse parties, to promote successful outcomes for biodiversity [77]. Ocean management decision-making processes are complex, needing to address a wide range of concerns across multiple marine resources uses, as well as to adapt to a changing global climate. Trends are moving towards understanding and appreciating resource usage and perceptions from multiple perspectives [8] and active stakeholder participation in these processes is becoming widely accepted as necessary [48,66].

Social licence, as a concept, has not been universally defined but for clarity, this paper considers it 'an unwritten social contract' [55] that reflects opinions and expectations of the broader community on the impacts and benefits of industry and government practices [25]. It is tacit permission that communities and society may grant for industry or government to utilise or control a resource (i.e. the marine environment, or components of it). Social licence occurs alongside other more formal legal requirements that may, or may not, explicitly require community involvement and consultation. Improved stakeholder engagement and empowerment help to promote learning and communication and generate holistic understanding of resource usage that are beneficial towards improving the capacity of ocean management in our changing world [59] and the literature increasingly champions the role of community in decentralising management [5,6]. Further, conservation planners have an ethical responsibility to include local community voices in management decision making [8].

Worldwide, the cultural identities of local communities are intimately linked to their traditional values and uses of the marine environment [3]. Recognition of the significance of these cultures and social objectives in resource management is growing, with increasing focus on novel concepts including the 'social licence to fish' [59] and

* Correspondence to: IMAS, Battery Point, Hobart, Tasmania 7001, Australia.
E-mail address: r.kelly@utas.edu.au (R. Kelly).

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there is great potential to explore how this may relate to cultural, social and individual 'rights to fish'. Nevertheless, there is limited guidance on how to advance this recognition towards actually incorporating social aspects of resource conservation into management and planning [8]. Broad differences exist in perspectives of sustainability, that revolve around the interaction of resource use and exploitation with other ecosystem components [37]. Social licence may play an important role in framing how stakeholder interests interact and how effective and collaborative management decisions can be achieved [55]. Incorporating 'bottom-up' approaches in management and encouraging communication and engagement amongst community and industry, can allow for more opinions to be heard and more ocean conservation objectives to be addressed [27,71]. There may be great potential for dialogic approaches towards defining social licence, as well as developing criteria for awarding it, managing it and sustaining it [60].

The purpose of this review is to assess how, and to what extent, social licence has been applied in the marine sector to date. It is likely that social licence, as a term, will continue to have currency given its widespread use but its evolution as a resource management tool will likely differ depending on industry, resource and project context [35]. Further, social licence may be used interchangeably with the concept of 'corporate social responsibility' (CSR) in industry and academic literature, but whilst there is substantial interaction between the two, they remain two distinct concepts [12]. CSR, as a broader concept, addresses the social responsibilities that emerge from the corporate-stakeholder relationship and social licence is a component of this, providing a platform for the development of a 'stakeholder-centric extension' of CSR within industry [34]. This paper's exploration focuses on applications of social licence in marine industries and management to identify future themes and areas requiring investigation and application in this realm. First however, social licence is defined from the terrestrial literature, exploring its origins, applications and development as a foundation for the later investigation of, and comparison to, the marine.

1.1. Social licence

Contemporary use of 'social licence to operate' first appeared in the mining industry as a metaphor, paralleling communities' influence and ability to stop mining projects with governmental ability to do the same [18]. Since Jim Cooney (Placer Dome Inc. mining company, Canada) coined 'social licence' in 1997 [17], it has become commonplace in the mining [20], oil and gas [76], forestry [25], paper-pulp mill [33] and wind power industries [34] amongst others [17,35]. This increasingly widespread use has allowed social licence to evolve from a metaphoric concept to a strategic management tool [18] that can be actively applied to planning and management in socio-political development.

Social *licence* suggests a governance role that perhaps proves misleading because there is not, necessarily, any formal process for attaining it [20]. Obtaining (and maintaining) social licence remains distinct (although often interrelated) from the formal licencing of permits and concessions by government and state bodies [43]. Instead, social licence is an informal social contract between industry (and resource managers) and community that must be earned and sustained on the basis of clearly demonstrated responsible performance as perceived by the community [18]. Legal licences are tangible and issued by governing authorities for fixed timespans but social licence is typically intangible and impermanent and must be earned and actively maintained over time [45]. Regulatory approval or licencing of an activity to proceed does not necessarily indicate that it has social approval or licence [25]. Social licence raises many questions about who is defined as 'community'; what thresholds exist for support and endorsement; and which processes or metrics are involved.

Social licence has no formal basis in law [76] yet it is subtly tied to many legal processes towards gaining legal licence. Obtaining social licence does not guarantee a legal licence to operate, but it may still become regulatory in requiring certain types of behaviour and imposing sanctions (i.e. withdrawn support) on a company that fails to comply with the expectations and demands of stakeholder groups [50]. Companies may now require social licence in addition to their legal obligations [60] and many licences require public consultation, as legal licencing alone has become increasingly insufficient in satisfying societal expectations. Whilst is has no legal force or standing, strong public opposition can directly affect the success of industry initiatives and industry recognise the need to obtain social licence to avoid potentially costly conflict with communities [62]. For these reasons, it is easier to identify where social licence has not been granted or has been withdrawn than where it exists, but positive indicators include, from [76]:

- *'The reduction or absence of vocal opposition to development,*
- *Continued and increasing constructive participation in community and stakeholder dialogue,*
- *Advocacy and expression of support for development,*
- *Cooperation in community-based activities and enhancement measures, and*
- *Willingness of key stakeholders to enter into partnerships or other forms of agreement'.*

Social licence reustry's engagement and relationship with communities of stakeholflects the changing quality and strength of indders [35]. It indicates 'ongoing acceptance' of a company or industry's activities [17] and has become a vital component of viable and sustainable resource use and development [43]. Industry play a central role in the construction of social licence because they are both the party seeking it and the party with direct influence over how engagement and communication with community can proceed. Poor engagement processes and negative reputations of community engagement may jeopardise the construction and maintenance of social licence [34]. Social licence cannot be considered a short-term achievement nor a linear process. Its evolution from metaphor to management tool arises from the efforts of community and industry to define and measure it to produce a potentially valid and applicable instrument [18]. Definitions and interpretations vary across industries and the literature but there is consensus that social licence has potentially at least as much influence as legal licencing [17] as both legal and social 'licences' can make or break an industry. It creates a new dimension for resource management – acceptance that must be obtained from all stakeholders affected by an industry's activities or resource usage [57].

Society is increasingly concerned as to how natural resources, including the marine environment, are utilised and developed and practices and uses that are not perceived as socially acceptable are unlikely to obtain social licence [25]. Some companies are adopting social licence as a component of their corporate responsibility strategy (CSR). Certainly, social licence can act as a means to realise the commitments made through CSR, which itself embodies certain principles and practices [12], but to achieve such acceptance, or 'social licence' [71], industry will need to prioritise communication and the strength of their relationship with stakeholders [34]. Different stakeholder and community groups identify and create different objectives and criteria for granting social licence and not all of these groups hold equal influence [76]. Ergo social licence is earned through a combination of efforts and activities; lead by timely communication and meaningful dialogue, encouraging and demonstrating ethical and responsible behaviours that can contribute to building trusted and credible relationships between industry, managers and community [76]. Since it origins, social licence has become less of a voluntary initiative and more a 'de facto prerequisite for development' and further, is a critical indicator of ongoing business viability [46].

Environmental management of ocean and coastal systems is difficult [47], with diverse opinions as to how resources and uses can be sustainably distributed. This review explores the discussion and application of social licence in this context, giving particular focus to marine protected areas (MPAs), aquaculture and fishery industries. Recognition is

growing that conservation initiatives such as MPAs can and in many cases should produce positive outcomes for both sustainability and development and the needs of the wider stakeholder community (i.e. resident communities, conservationists, fishers, government, tourists) [10], however marine management literature catalogues the contentious nature of these protected spaces [67]. Historically, MPAs have been established to fulfill biological objectives but in sites where human dimensions have largely been ignored, 'biological success' may simultaneously result in social harm (i.e. conflict over resources and space, economical losses, etc.). This paper explores how understanding and accounting for the broader social benefits and impacts of MPAs may have potential to increase their social licence, success and long-term existence [51].

A growing global focus on incorporating communities in management processes has seen the concept of sustainable fisheries include concern for the wider impacts of marine fisheries, including its ecosystem effects [31]. Still, fisheries and their management remain contentious issues in the public sphere. Increasing global demand for seafood has resulted in a rapid expansion of the aquaculture industry [58]. Notwithstanding, communities of stakeholders are increasingly aware of the industry's environmental costs and impacts [73] resulting in conflict that typically stems from community concerns about the negative social and environmental impacts of aquaculture farm sites. Here, examples of literature discourse are used to illustrate development, and instances of withdrawal, of social licence in marine aquaculture and fisheries and MPAs.

2. Methods

The objective of this review was to collate and synthesise instances of social licence in the marine realm as documented in the literature, explore its uses and interpret its development in the marine context. The review sought to create a concise picture of its standing, understanding and application within ocean industries and the marine environment to better inform future development and research of social licence in the marine realm. Literature searches were conducted across three main databases: Scopus, Web of Science and ProQuest (Fig. 1). All searches enquired for either:

'social licence''marine'*
'social licence' 'ocean'
*'social acceptability'**'marine', or*
'social acceptability' 'ocean'

*Both 'licence' and the alternative spelling, 'licence' were enquired for in the database searches.

**'Acceptability' was included because it is commonly considered the first step in achieving social licence [18] and is sometimes used synonymously with 'social licence' [71]. Thus, this term was considered important in reviewing social licence in the relatively new context of marine systems.

Overlaps in papers between the three databases were counted only in the first database they were recorded. Abstracts of every publication yielded at this stage were read to insure their eligibility and those outside of marine focus or English-language literature were discarded. The remaining papers (N = 70) were read in full and the topic of each paper was documented (i.e. industry, management, etc.), along with its reference to 'social licence' and/or 'social acceptability'.

The references cited in eligible papers (N = 54) were screened to be included in the final review. The same methodology was used, but criteria were extended to include 'public support' and 'opposition'. These papers had been sourced from articles confirmed to include 'social licence'/'acceptability' and were largely expected to discuss themes of social licence, even where they did not explicitly describe or define them. Further, 'support' has been used synonymously with 'social licence' to describe engagement between community and industry (i.e. [20]). Once this systematic review was completed and a final set of articles were retained (N = 68), the themes and criteria within papers were identified and recorded. The issues and themes discussed in this literature was further explored by supplementing from grey literature (e.g. ministry reports, industry documents, etc.), to better illustrate the concept of social licence in the broader marine context.

3. Results/discussion

Of the papers collated in this review, the oldest was written in 1999 [67] and the number of articles published since then has gradually increased over time (Fig. 2), indicative of the growing interest in social licence in the marine sector. The term 'social licence' was referred to (in a marine context) in 11 out of N = 68 papers (16.18%), and 'social acceptability' in 54 (79.41%). Other terms documented were 'support' (27.94%), 'acceptance' (17.65%) and 'opposition' (5.88%). It is not surprising that 'social acceptability' is more frequently discussed in the literature. As outlined earlier, it is considered the primary step to achieving social licence [18] and where documented, authors are more

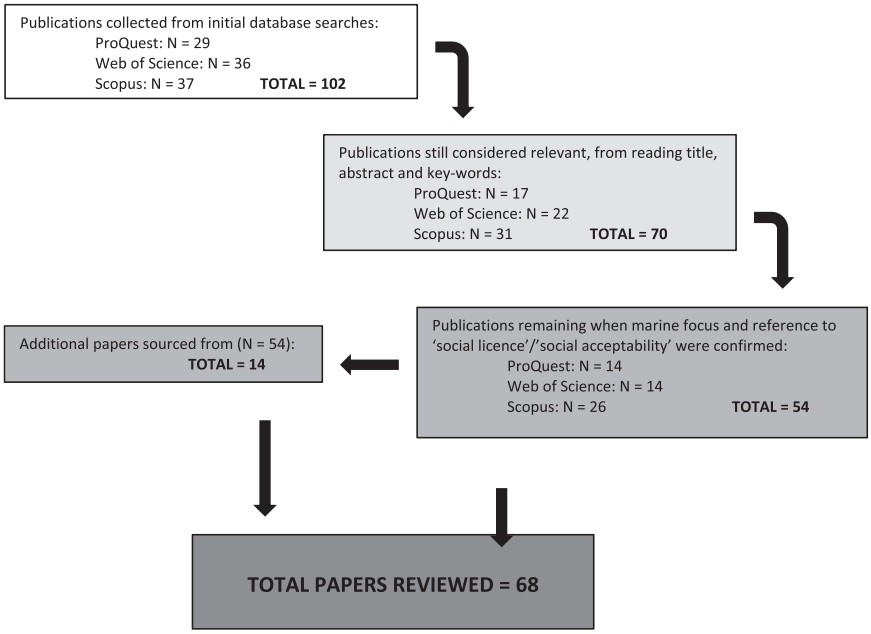

Fig. 1. Schematic of the review process. Papers were collated from three main literature databases and the final set of review papers was obtained through this refinement process.

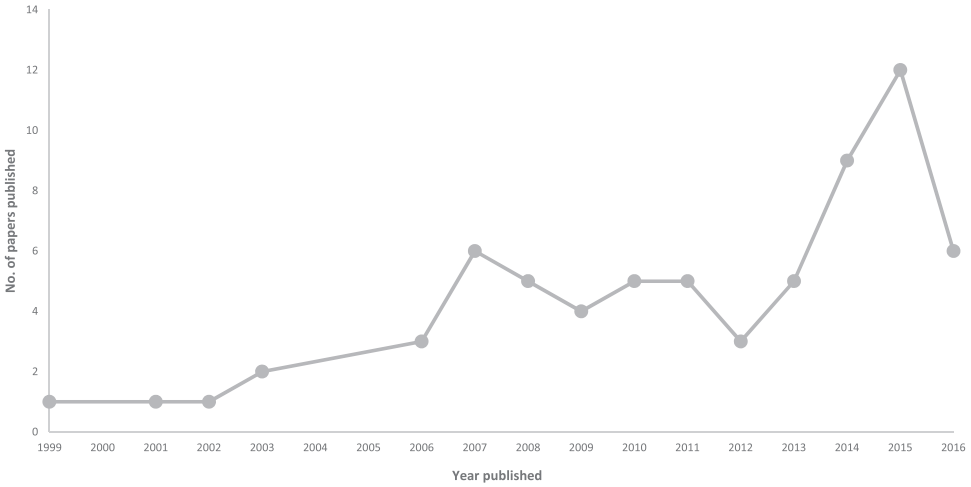

Fig. 2. No. of published papers citing social licence in a marine context from the years 1999–2016.

likely to discuss budding social licence initiatives or 'where it should occur' than examples of long-term, established social licence in marine industry.

Of the set of papers that explicitly referred to 'social licence', only five of the articles sourced from the databases offered any concise definition as to what it means or entails [16,38,41,52,63], highlighting a gap in the literature in understanding how social licence could be defined in the marine realm (Table 1). Within these, they described social licence as an 'implicit contract' [63] that requires industries operating within local areas and communities to secure free, prior and informed consent from the community [38] and emphasised that whilst it bears no legal standing, failure to obtain (and maintain) social licence from key stakeholder groups can have negative implications for marine industry [52]. These follow in accord with definitions taken from the terrestrial literature [19,35,57], bolstering the argument that knowledge and experiential data from these industries can likewise be applied to the marine realm.

Interestingly, social licence was also considered 'a tool' for marine industries to manage their socio-political interests by adhering to concerns and stipulations as imposed by communities and stakeholders. Moreover, it was suggested that this 'tool' could be used to encourage and foster public, private and civic sector cooperation towards sustainable development in marine systems [63]. The value of social licence has certainly been documented in this literature and recognised as 'essential' to the future viability of many marine industries [41]. This is in consensus with the grey literature, where it is suggested that fishers and fisheries will need to generate and sustain 'the rapidly emerging topic of social licence' [75] if they are to continue to access publicly owned ocean resources [28]. The development of social licence in the marine realm will likely require coordinated effort at all levels of industry [61].

Several themes dominated the content and focus of the total set of papers collated (see Appendix A), the most common of which were marine management and conservation, aquaculture and fisheries. These three themes are explored in more detail below.

3.1. Marine management and conservation

Management was a predominate topic across the papers collated (89.71%) however, these also discussed a broad range of other themes and a variety of industries. Unsurprisingly 'Conservation' and 'Marine Protected Areas' (MPAs) were prominent topics under discussion within the literature (13 papers each respectively; combined, with overlap, 35.29%). This is reflective of growing recognition of the need for new approaches to marine management [2,3,39,65], engaging with, and incorporating local communities in associated decision-making processes [11]. The literature affirms that similar to terrestrial experiences, social acceptance in the marine is dependent on the effectiveness and quality of management and government institutions as perceived by stakeholders [11] and that such management must focus on anticipating and reducing conflict [68]. Social data may play a significant role in marine management and decisions made without adequate consideration of socio-ecological components could risk undesirable social reactions [42].

Promoting social licence of and for MPAs is a key challenge globally [72] and the literature underlines how critical social acceptance is for successful MPAs [1]. Improved engagement and community participation in conservation and governance schema may provide 'agents of change' to enhance conservation approaches and discourse [22]. However, whilst social acceptance is critical in determining MPA success it remains a poorly explored area of research [68]. Developing clear understanding of how different stakeholder groups utilise and value marine resources and spaces, including MPAs, is a logical step towards improving marine management practices [21]. MPAs do not

Table 1
Papers collected that explicitly refer to 'social licence' in the marine context. The table outlines the nature and context of the literature obtained that explored social licence in the marine domain.

Author	Year	Definition	Industry	Conflict	Indigenous	Management/Planning	Australian	International
Tollefson & Scott	2006		Aquaculture	I	I			I
Boughen et al.	2008	I	Seafloor exploration	I		I	I	I
Mason et al.	2010	I	Seafloor mining		I	I	I	
Rogers et al.	2014		Biodiversity offsets, Oil & gas		I	I	I	
Fulton et al.	2014		Fisheries			I	I	
Campbell et al.	2014		Marine littering				I	
Kerr et al.	2014	I	Marine renewable energy	I		I		I
Hobday et al.	2015	I	Conservation, Climate Change			I	I	
Richert et al.	2015	I	Conservation, Oil & gas	I		I	I	
Voyer et al.	2015		MPAs		I	I	I	
Voyer et al.	2015		MPAs	I	I	I	I	

only serve to provide protection for critical habitats and threatened species. They also function as important platforms for outreach and education on the socio-economic and ecological benefits of marine resource conservation [3]. Identifying divergent perceptions between stakeholder groups will guide management towards understanding the issues and reasoning behind support and opposition [68] and ultimately, gaining social licence for MPAs.

Voyer et al. [71] demonstrated, by means of two Australian-based case studies, how local cultural, historical and demographic characteristics can play a significant role in how local stakeholder groups perceive MPAs and grant social licence. The paper's analysis and comparison between two protected sites illustrated the importance of 'recognising and encouraging diverse opinions and ideas' in achieving marine conservation objectives. Their results emphasised that neglecting to address communities' concerns and adapt management accordingly will likely exacerbate conflict and fuel opposition towards an MPA. Contrasting the management and stakeholder engagement conducted at each site, Voyer et al. showed that community trust in management and industry is 'crucial to obtaining social licence'.

3.2. Aquaculture

Global seafood supply and demand render marine aquaculture a permanent fixture on the marine environment. Attaining and retaining social licence is critical for sustainable development in the aquaculture industry [9]. Community perceptions and attitudes towards aquaculture are based on their awareness and knowledge about the natural resources and environments that industry are exploiting [53]. Undoubtedly, granting social licence in aquaculture will be founded on community perceptions of the industry's environmental record [74]. Past failure of aquaculture to acknowledge and appreciate the extent of stakeholder diversity may impede their ability to respond to public concerns and exacerbate mistrust in the industry [53].

In their 2006 paper, Tollefson & Scott evidence how withdrawn social licence can also influence regulatory reform:

> *'Community input will play a significant role in determining whether an operator's resource consent will be renewed'*

Their investigation compares two aquaculture industry evolutions, in New Zealand and British Columbia, Canada. The paper examines opposition to aquaculture as demonstrated by indigenous communities, but also provides good insight into local community dynamics and opinions more generally. It outlines the 'magnitude and furor' of debate and opposition to New Zealand's shellfish aquaculture that occurred in the early noughties as a result of rapid growth and the concurrent public view that the industry was 'growing too quickly'. The article emphasises the interdependency between industry development and its need to recognise and address local community concerns and interests. Contrasting the New Zealand experience to a more juvenile Canadian industry, they highlight the necessity for industry to address the 'needs, interests and rights' of local communities to better inform decision-making that can generate the community support and licence upon which industry expansion will depend on. The paper exemplifies how an absence of strong social licence can fuel long-simmering debate and stagnate progress in marine industry, iterating this review's observations of a need to consider social engagement and licence from preliminary development stages.

The main objections to the establishment and development of aquaculture are its effect on marine ecosystems and surrounding environment [40] and its impact on community uses and cultural activities [69]. Poor engagement and knowledge-sharing on production processes, impacts, and product quality may lead to distrust and opposition amongst the wider stakeholder community [7]. Acknowledging and attempting to understand the diversity of perceptions within stakeholder groups can reduce misunderstandings and identify critical issues to be resolved to achieve socio-economic and environmental sustainability in aquaculture [7]. Social acceptability can be promoted where socioeconomic benefits of the industry are clearly demonstrated and communities are well informed on the environmental impacts of aquaculture, as well as the regulatory and management processes that industry must comply with [73]. Likely, potential exists for social licence to be bolstered and improved within the aquaculture industry and its governmental regulation and policies [73]. It will need to recognise that communities can act as 'de facto regulator of the industry' [33] and work to achieve their consent, approval and social licence. Future work could investigate how communities perceive aquaculture and farm sites, how they regard possible and future development, and how these opinions and attitudes are constructed [40]. Negative attitudes towards aquaculture, that can impede development of the sector, are often a result of poor knowledge about the industry and its activities. There may be great potential in applying discourse analysis to allow a diversity of interests to be articulated, and to identify conflicts between stakeholder groups, providing a starting point for negotiation processes in aquaculture industry [29].

3.3. Fisheries

Of the nine fisheries-focused papers (13.24% total papers analysed) obtained in this review, only one explicitly referred to 'social licence' [31] but this paper did not provide any definition of social licence or explanation about how it is conceived within marine fishery industries. Specifically, it explored the management of a complex multispecies fishery in SE Australia and determined that this fishery's 'social licence is low' due to poor ecological status and the impacts of lobbying on the setting of total allowable catches. A primary reason for management failure in fisheries is conflict between ecological requirements and social and economic priorities; frequently, the latter take priority in resource conservation. A dearth of reference to social licence in marine fisheries research suggests a need for more emphasis to be placed on socio-ecological interest, towards achieving desired sustainable fishery management outcomes. Management impacts are often culturally and context specific and may have poor success where social aspects have not been specifically addressed or integrated [54]. Commercial fishers, for instance, may hold a very strong 'sense of place' or personal connection to areas that have special or unique characteristics that can foster personal attachment and belonging [70]. Further, fisheries problems can influence larger socio-ecological problems, where fisher incomes often play a greater role than other fisheries problems in isolation [54]. Local context and experiences will need to be identified and incorporated in management if fisheries are to obtain community support and social licence.

Resource users are likely to hold more positive perceptions towards fisheries when they have been actively involved in management decisions from the primary stages [54]. In the absence of stakeholder forums, resource users may focus on selfish interests and authorities become isolated and inflexible. Participatory meetings that allow stakeholder groups to express and exchange opinions are a primary step towards integrating ecosystem sustainability requirements and the needs of resource users [54] and ultimately, generating social licence. Individual groups experience and potentially manage fluctuations in their own social licence and legitimacy is developed and validated through tensions, negotiations and cooperation between these various groups and organisations [47]. For example, the arrival of the *Abel Tasman* supertrawler to Australian waters demonstrated the 'emerging role of social licence in decision making' [36]. Reportedly the world's second largest fishing vessel, the proposed entry of the supertrawler into Australian pelagic fisheries raised considerable public dispute. Public opposition, voiced loudly by recreational and game fishers as well as environmental groups, led the Minister for Fisheries to revoke accreditation of the vessel, eventually resulting in its departure from Australian waters. This case demonstrated that whilst social licence has no legal standing, legitimising processes may be abandoned in the face of perceived or actual dispute, or lack of social support or licence.

Australian-based research accounted for 25% of the literature

collated in this review. Australian investigations into social factors affecting development in the marine realm are perhaps unsurprising when we consider that its beaches and ocean habitats are iconic and significant to the nation's culture, as well as its recreation and tourism industries [52]. Further, Australia has one of the world's largest maritime jurisdictions, encompassing an area of approximately 14.5 million km^2, and 85% of the population live within 50 km of its coastline. Social licence has been widely discussed in terrestrial industries in Australia [13,18,56]; etc.

The term 'social licence' entered mainstream media not long after it was first coined in the US and has been documented in Australian media ever since [49] and much investigation into its development and application has been achieved in business and terrestrial industry (i.e. [14]). Public conflict and opposition to forestry development on the island state of Tasmania, for example, has positioned it as a 'world leader in environmental conflict' [49]. Tasmanian society is considerably divided on issues of biodiversity conservation and commercial resource use [44]. Community opposition to the state's forestry industry has had a global audience since the 1970's, when the United Tasmania Group (the word's first 'green' party) was established, yet it wasn't until 2010 that the industry publicly acknowledged social licence as central to securing its viability on the international market [49]. In 2014, Tasmania imposed a moratorium on the expansion of its state MPA system as a result of fisher pressure on governmental bodies [44]. Australia's island state lags far behind its mainland counterparts in coastal and oceanic protection, its marine reserves totaling 2.67% of its water jurisdiction. Fishers are concerned about the effect of closed areas on fishing stocks and political support for Tasmanian MPAs is unlikely to be forthcoming in the near future. Local and community ability to influence political decision-making particularly through 'lobbying', as demonstrated in Tasmania, has set a precedent for developing social licence in natural resource management [24]. Potential exists for an exploration of public perception and social licence dynamics in this marine space. Further, developing social licence understanding and the potential for its application as a tool on an international level is another pertinent area of investigation warranting address.

Assessing social licence after it has been granted or withdrawn is difficult, and attempting to assess it before it has been secured may prove even more problematic. Given its intrinsic nature, recognising social licence 'in action' is difficult and it may be easy to assume its existence or conversely, difficult to prove its absence [60]. Still, attention to social issues are required if we are to identify factors that may hinder the progress of conservation initiatives [38]. Community diversity will need to be identified and explored if their opinions are to be heard and responded to by industries of marine renewable energy [41]. Overcoming community resistance is not the only facet to obtaining social licence for an MPA, or social licence more generally Voyer et al. [71]. highlighted the link between opposition to MPAs and the environmental knowledge of its communities of users but public perceptions are not always founded on technical knowledge and may even conflict with expert and scientific advice. It cannot be assumed that by providing more 'facts' and information industry can garner greater stakeholder support [41]. Withheld social licence has potential to override legal licencing and prevent or delay developments and those influencing, permitting and responding to social licence should proceed transparently and ethically [52] but social acceptability is likely to change over time, as society becomes more familiar and grows more comfortable with conservation measures and management outcomes [38]. Social licence is certainly dynamic and impermanent because opinions, beliefs and perceptions change and adapt as new information is acquired and assimilated.

4. Conclusion

This review recognises, and the literature affirms, that social licence is an emergent concept in the marine sector. Interpretations of social licence are many and varied (e.g. [17,45,57] and a coherent definition is lacking. Although 'social licence to operate' is increasingly being utilised in both the media and academic literature [17], its meaning is often applied loosely, with no reflection as to how it actually affects societal realities or influences managerial decisions [60] Boutilier [17] advise that the spread of the term 'social licence' across various sectors and industries is not accompanied by a consistent understanding of its connotations and implications.

As social licence becomes referenced more widely, the danger prevails that its meaning could become so blurred that it loses value as a tool for engaging communities and promoting collaboration. However 'loose' meanings and concepts may allow for common ground to foster collaborative thinking and engagement, and may prove conducive to constructing social licence in the marine realm [26]. Specificity can limit society's ability to move beyond definition and respond appropriately to current and future scenarios [26], particularly in a space so diverse as the marine. The authors of this review embrace the fact that social licence cannot be clearly defined [20] or easily quantified [63]. It further adds to its appeal, if it can be used opportunistically and contextually, to serve the interests of industry, community and government [32]. Future work needs to determine the best means by which social licence can be developed.

Undisputed public resources do not exist. Socio-ecological approaches, encapsulating dynamic interests of both human and natural systems, are necessary for the long-term management of marine environments under our changing climate [30]. Such exchange is fundamentally underpinned by trust [23], another complex component of balancing relations between community, industry and government [15]. Gaining social licence implies creating and maintaining public trust that industry and management are utilising marine environments and resources ethically, in accordance with community expectations [28]. Discourse and engagement are integral to its developmental process [64] and much can be gained by exploring how social licence is attained and applied in the marine realm.

To date, limited research has been conducted into the processes involved in obtaining social licence and the factors attributed to maintaining it [56]. Much could be achieved in exploring how, when and where social licence can be attained, for example, what thresholds exist for support and endorsement and which processes or metrics are involved. At this novel stage, social licence presents a promising means to develop dialogue between stakeholders involved in, or affected by, resource use and development [55]. It is not yet clear whether the concept of social licence relates in the same way to operational activities (i.e. industry, fisheries) as it does to non-operational activities such as conservation activities or MPAs and this is certainly a gap in need of further research. The marine and coastal environment is a public resource and the public is its primary stakeholder. Exploring who its community of stakeholders are, how they withhold and communicate social licence, and how these marine stakeholder groups interact amongst themselves may have great potential to better inform decision-making processes, promoting more robust and complete outcomes for ocean conservation. The outcomes of this review suggest that by designing and implementing marine management that can appropriately and meaningfully accommodate social uses and interests, social licence may have potential as a tool to foster engagement and stewardship, promoting ocean conservation within local and broader-scale community groups.

Appendix A

See Table A1.

Table A1
Summary of the papers (N = 68) collated in review, identifying the theme/industry discussed in each paper.

	Author	Year	SL	SA	Management/Planning	Industry
	Neori et al.	2007		1	1	Aquaculture
	Chu et al.	2010			1	Aquaculture
	Ridler et al.	2007		1	1	Aquaculture
	Mazur and Curtis	2008		1	1	Aquaculture
	Bacher et al.	2013		1	1	Aquaculture
	Chopin et al.	2001		1	1	Aquaculture
	Katranidis et al.	2003		1		Aquaculture
	Troell et al.	2003		1	1	Aquaculture
	Mazur and Curtis	2006		1	1	Aquaculture
	Whitmarsh and Palmieri	2009		1	1	Aquaculture
	Barrington et al.	2009		1	1	Aquaculture
	Whitmarsh and Palmieri	2011		1	1	Aquaculture
	Freeman et al.	2012		1	1	Aquaculture
	Alexander et al.	2016		1	1	Aquaculture
	Perdikaris et al.	2016		1	1	Aquaculture
	Tollefson and Scott	2006	1			Aquaculture
	Freitas et al.	2007			1	Aquaculture, Conservation and/or marine management
	Buck et al.	2008		1	1	Aquaculture. Wind energy
	Schuett et al.	2016			1	Artificial reefs
	Rogers et al.	2014	1		1	Biodiversity offsets. Oil & gas
	Harman et al.	2015		1	1	Coastal protection
	Goeldner-Gianella et al.	2015		1		Coastal protection
	Smithem and Mazzotti	2008			1	Conservation and/or marine management
	Röckmann et al.	2015			1	Conservation and/or marine management
	Poumadere et al.	2015		1	1	Conservation and/or marine management
	Thébaud et al.	2015		1	1	Conservation and/or marine management
	Shapiro et al.	2016		1		Conservation and/or marine management
	Glaser et al.	2015		1	1	Conservation and/or marine management
	Neff	2012			1	Conservation and/or marine management
	Jones & Clark	2013		1	1	Conservation and/or marine management, CC
	Hobday et al.	2015	1	1	1	Conservation and/or marine management, CC
	Bennett & Dearden	2014			1	Conservation and/or marine management
	Metcalfe et al.	2015			1	Conservation and/or marine management
	Gall & Rodwelll	2016		1	1	Conservation and/or marine management
	Richert et al.	2015	1		1	Conservation and/or marine management, O & G
	Oinonen et al.	2016		1	1	EU MSFD
	Glass et al.	2015			1	Fisheries
	McClanahan et al.	2009		1	1	Fisheries
	Ban and Vincent	2009		1	1	Fisheries
	Martinet et al.	2015		1	1	Fisheries
	Fulton et al.	2014	1		1	Fisheries
	Nauen	2008		1	1	Fisheries, Aquaculture
	van de Geer et al.	2013		1	1	Fisheries, Conservation and/or marine management
	Adams et al.	2011		1	1	Fisheries, Conservation and/or marine management
	Machumu et al.	2013		1	1	Fisheries, Tourism
	Trenouth and Campbell	2013			1	Invasive species
	Campbell et al.	2014	1			Marine littering
	Kerr et al.	2014	1	1	1	Marine renewable energy
	Stump and Kriwoken	2006			1	Conservation and/or marine management
	Bennett and Dearden	2014			1	Conservation and/or marine management
	Suman et al.	1999			1	Conservation and/or marine management
	Thomassin et al.	2010		1	1	Conservation and/or marine management
	Voyer et al.	2014		1	1	Conservation and/or marine management
	Voyer et al.	2015	1	1	1	Conservation and/or marine management
	Voyer et al.	2015	1	1	1	Conservation and/or marine management
	Himes	2007		1	1	Conservation and/or marine management
	Healy et al.	2002		1	1	Ports
	Boughen et al. [16]	2008	1		1	Seafloor exploration
	Mason et al.	2010	1	1	1	Seafloor mining
	Mabon et al.	2014		1	1	Sub-seabed CO2 storage
	Devine-Wright	2011				Tidal energy
	Conway et al.	2010			1	Wave energy
	Bailey et al.	2011			1	Wave energy
	Tatar and Lee	2012		1		Whaling
	Lacroix and Pioch	2011		1	1	Wind energy
	Kermagoret et al.	2014		1	1	Wind energy
	Firestone and Kempton	2007			1	Wind power
	Maruyama et al.	2007		1	1	Wind power
Total Papers			**11**	**45**	**61**	
% Papers			**16.18**	**66.18**	**89.71**	

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Social Licence for Marine Conservation Science

Rachel Kelly[1,2]*, *Aysha Fleming*[2,3] *and Gretta T. Pecl*[1,2]

[1] *Institute for Marine and Antarctic Studies, Hobart, TAS, Australia,* [2] *Centre for Marine Socioecology, University of Tasmania, Hobart, TAS, Australia,* [3] *CSIRO Land and Water, Hobart, TAS, Australia*

Marine environments are complex and dynamic social-ecological systems, where social perceptions of ocean stewardship are diverse, resource use is potentially unsustainable, and conservation efforts rely strongly on public support or acceptance. Decreasing trust in science in recent years has led to weakened social acceptance and approval of marine conservation science. Social licence is a concept that reflects informal, unwritten public expectations about the impacts and benefits of industry and government practises, including research, on natural resources, including the ocean. Working toward improving social licence may provide opportunity to bolster support for marine conservation, by allowing communities to engage with marine issues and marine science, and voice their concerns and views. Here, we argue that marine conservation requires social licence and we highlight science advocacy, accomplished through outreach, as a means to achieve this. We identify a role for marine conservation science to engage with the public through advocacy to improve understanding and perceptions of conservation. Drawing from the literature, we describe how science advocacy can enhance social licence for marine conservation research and outline four steps that can advise marine conservation scientists to achieve and promote social licence for their research and the wider marine conservation community.

Keywords: marine conservation, public perceptions, science advocacy, social licence, science communication

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***Correspondence:**
Rachel Kelly
r.kelly@utas.edu.au

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INTRODUCTION

Marine environments are complex and dynamic social-ecological systems, where social perceptions of ocean stewardship are diverse, resource use is potentially unsustainable, and conservation efforts rely strongly on public support or acceptance. Globally, there is increasing awareness that society must be engaged in efforts to tackle marine conservation challenges. In parallel, there are increasing calls for scientists to engage more actively with society, to address publicly identified issues and questions and to improve perceptions of legitimacy of marine conservation science (Lubchenco, 2017). Trust always matters in the public sphere and whilst scientists may be regarded as "competent," this does not infer that they are also considered trustworthy (Fiske and Dupree, 2014). Issues around the public legitimacy of science are not necessarily based around public ignorance or understanding of science (Kellstedt et al., 2008). Personal beliefs also shape public perceptions of science and are distinct from a poor, or lack of, understanding about science (Fiske and Dupree, 2014).

Social licence is a concept that may be used as a tool to incentivise the public to voice concerns on marine issues that may otherwise remain unnoticed or ignored (Cullen-Knox et al., 2016). To date, no consensus definition of the concept has been achieved however, we, in this paper, consider it "an unwritten social contract" (Moffat et al., 2015) that reflects broader community opinions and expectations on the impacts and benefits of industry and government practises, including research (Edwards and Lacey, 2014). Social licence provides opportunity for ongoing engagement and two-way negotiation with the public and thus, reflects the "changing strength and quality of acceptance and approval afforded by a community of stakeholders" (Hall et al., 2014). The concept is now considered essential for successfully establishing and running natural resource projects (Hall et al., 2014) and may have potential to foster engagement and stewardship in the marine space and for ocean conservation (Kelly et al., 2017).

Social licence is founded on meeting diverse and dynamic community (stakeholder) expectations, solid relationships and meaningful communication (Hall et al., 2014; Rooney et al., 2014). In exploring its use in marine conservation science, the need for social licence can necessitate the practise of effective scientific communication (Gallois et al., 2016), which can bolster outreach and advocacy efforts. Opening public discussion and providing more accessible scientific information can improve trust and strengthen relationships with society (Mason et al., 2016), and science advocacy is a means of public engagement that can improve public awareness of, and trust in, science. In this paper, we define science advocates as people who work for a scientific cause or group, and who engage in science outreach activities to inspire and teach about science (Carney, 2014).

Whilst social licence for conservation has been discussed in the literature (i.e., Kendal and Ford, 2017; Garnett et al., 2018), to date and to our knowledge, no literature has discussed a need for marine conservation scientists to "earn" social licence. Certainly, decreasing trust in science has weakened social acceptance and social licence for marine conservation and science in recent years, and scientific priorities are often misaligned with marine stakeholder priorities (i.e., Mason et al., 2016). Within science culture, scientists' engagement with society is often viewed as an inferior pursuit to research (Martin, 2017). The prevalent "publish or perish culture" commends academic accomplishment over public engagement when allocating tenure, and this is a structural limitation for scientists who recognise the value of public science engagement, but who will receive no accreditation for their efforts.

Another hurdle for scientists willing to engage is that scientists are trained to communicate their research via "the scientific method" (Green et al., 2018) and as a result, the readability of scientific papers is decreasing over time (Plavén-Sigray et al., 2017). Acknowledging uncertainty in research outputs is also a practise that is inherent to science, but which can diminish the perceived public legitimacy and authority of science (Zehr, 2000). The communication of marine conservation science will inevitably involve uncertainty and marine scientists should be aware as to how this can potentially undermine public incentive to respond to threats and deterioration in the marine environment. Scientific uncertainty may promote public disengagement and the deference of any responsibility and urgency for action (Morton et al., 2010).

Marine conservation scientists should not assume that the "public" (typically including coastal and fishing communities, indigenous groups, policy makers and others) share their world views and assumptions about marine environments and resources (Kohler and Brondizio, 2017). Gaps are often apparent between the public's and marine scientists' perceptions of threats to the marine environment (Lotze et al., 2018). Societies' lack of trust in expertise of all kinds, including science and government, has heightened globally in recent years (Nichols, 2017), with academics and their institutions regarded as ivory towers conducting research in isolated realms. Suppression and distrust in science is a global phenomenon and conservation science is increasingly seen as irrelevant (Parsons et al., 2015). Modern marine conservation challenges demand a "hands-on" approach, whereby scientists can respond to public needs transparently (Lubchenco, 2017).

The vast majority of marine science remains outside the public's direct experience and the public depend on other parties to inform and guide them in their interpretation of ocean science. Whilst science communicators have an invaluable role to play in science outreach (which we discuss below), scientists must also communicate their science to earn and maintain public trust. Third-party communication distances the public from science and may create distrust. Further, scientists risk their message being lost or miscommunicated by messengers who might not understand the true complexity of the science, or the importance of framing issues in context. Science outreach and advocacy, by marine conservation scientists, can engage communities in marine issues, and improve their perceptions of marine science and conservation.

Science outreach, more generally, centres around building capacity, fostering trust and developing scientific understanding (Varner, 2014). Science advocacy employs outreach, but focuses on ensuring that specific scientific outputs are shared with relevant people (i.e., a targeted "public") in formats that are clearly understandable to them (Parsons, 2013). Advocacy can be considered a more personal means of communication because scientists can voice personal elements of their work and research to form a connexion with the public, and build trust through this relatedness and transparency. Science advocacy may provide a means to build rapport with society and elicit a connexion, to earn legitimacy, support and thus, social licence for marine conservation science.

Science outreach and advocacy can also substantially impact upon scientists, who become more aware of public views relevant to their own science, and gain a variety of skills not formally taught in degree training (Beck et al., 2006). Further benefits may incentivise marine scientists to engage in outreach and advocacy activities. For example, the March for Science recognises this need for publicly communicated science and has become an international "force for science advocacy," that champions the role of science, to ensure its role and relevance in political decision-making. Scientific research remains largely publicly funded and society expects that its investment in science will

yield the best science available, to produce something useful (Lubchenco, 1998). Outreach and advocacy are necessary to ensure that the public are informed about this best and useful science, and public engagement is increasingly an obligation for scientists. This is evidenced by funding schemes, such as the Australian Research Council's National Innovation and Science Agenda, which require supported researchers to engage with the end-users of their science.

Modern scrutiny of science requires scientists themselves to earn credibility. The ocean is often considered the "next frontier" of conservation but activities in conservation increasingly require public support and social licence to be successful (Bennett, 2018). Here, we argue that marine conservation requires social licence and that science advocacy (via outreach by marine conservation scientists) may provide a means to achieve this. We identify a role for science advocacy to enhance social licence for marine conservation research and highlight four key steps that can advise marine scientists to achieve and promote social licence for the research that informs and underpins marine conservation.

While not all scientists can, will, or need to engage in outreach and advocacy, marine conservation science in particular, as a field that is so germane to communities, needs to promote its research more clearly to the wider public. Developing respectful dialogue with society may allow marine conservation scientists to earn respect as a source of factual information and expertise. Passionate workers in their respective fields, many conservation scientists are likely already advocates without realising it (Parsons, 2016). Sharing this passion and advocacy with their wider community can enhance their credibility and promote social licence for marine conservation science. Below, we elucidate four steps for marine scientists to advocate their research, and build social licence for ocean research that underpins marine conservation.

ENGAGE WITH OTHER DISCIPLINES: APPRECIATE THE VALUE OF SOCIAL SCIENCE

The need for social licence highlights the important role of human dimensions and public perceptions in conservation (Kendal and Ford, 2017). A scientifically engaged society can empower and incorporate the public in constructing democratic, scientifically informed governance and decision-making, and this promotes social licence for science. The vast majority of marine conservation science occurs outside of the public sphere and the public depend on other parties to explain and guide their interpretation of marine science. We cannot expect that marine scientists and conservationists can expand their skills toward understanding public perceptions of science, and conducting science advocacy in response, on their own. Multidisciplinary discussions with social scientists, natural scientists, educators, psychologists, conservation marketing and others can connect diverse perceptions to enhance communication on marine conservation science and practise. Public perceptions research may be a valuable source of information to identify and understand society's diverse interpretations of marine science and conservation (Jefferson et al., 2015).

Interdisciplinary marine research is becoming more prevalent (i.e., Thébaud et al., 2017; Alexander et al., 2018). Marine protected areas research, as an example, has evolved from managing areas for biological conservation, to also incorporating social dimensions that promote sustainable resource protection adaptive to social and ecological needs (Agardy et al., 2003). Interdisciplinary marine research, similar to science advocacy, is not without its challenges (Alexander et al., 2018). However, interdisciplinary training (or at least, understanding) is a tool that allows a new generation of researchers to reconsider their research objectives, adopt new approaches that compliment other spheres of research and enhance socio-ecological outcomes that can promote social licence for marine conservation science. Early-career researchers are increasingly educated and encouraged to conduct more applied research, to collaborate across disciplines and to engage with local communities. Certainly, the global conservation community is adopting more collaborative and integrated approaches for conservation (Bennett and Roth, 2018) and there are increasing opportunities for researchers to collaborate across disciplines and with society, including workshops, summer schools and conferences, such as International Marine Conservation Congress.

UNDERSTAND THAT SCIENCE HAS MULTIPLE AUDIENCES: THERE IS NO "GENERAL" PUBLIC

The public funding that supports most scientists infers a social responsibility to address public needs and to share science with society to maintain a "social contract" or social licence for their research (Lubchenco, 1998). Be it with policy-makers or the public, scientists should acknowledge that scientific language can have variable applications and consequences, dependent on communicator, audience, and context (Gallois et al., 2016; Drakou et al., 2017). Jargon and slang can produce wedges of misunderstanding, not only excluding stakeholders but also eroding trust between them (Mason et al., 2016).

Effective communication requires speaking in "languages" that people understand, it is based heavily on trust and thus, scientists are required to communicate clearly and honestly (Cooke et al., 2017). Marine conservation scientists, perhaps more than other scientists, should to be willing to "leave [our] comfort zone behind," to communicate across different languages, research in new circles and welcome other opinions (Mascia et al., 2003). Marine conservation scientists can create and adopt new languages and in some cases, let go of their familiar definitions and assumptions and work to accept ambiguity, if this can create positive engagement with science (Fleming and Howden, 2016). For instance, improving the accessibility of scientific writing, to a range of audiences with different needs, can boost the impact of academic publications in a practical and applied sphere outside of the lab (Doubleday and Connell, 2017).

Inaccessibility is an oft-cited reason for lack of trust in information, particularly digitally available information (Hart and Liu, 2003). The online scientific newspaper "The Conversation" is a platform which allows scientists (and others) to communicate their research in easily-understandable formats, as a freely available resource. The paper's growing readership is indicative of the public legitimacy and trust it has achieved since its development. Marine conservation scientists, for example, can work to increase their relevance and legitimacy by sharing their science, via adapted research papers, with a broader public readership.

Marine conservation scientists should also be aware that online platforms continue to alter the means by which public information is accessed and opinions are formed. The internet has become the "go-to" and preferred source of public information on science. Online users are observed to focus on limited sets of websites and entrench themselves within distinct online communities, or "clusters" (Schmidt et al., 2017). This promotes "confirmation bias," the tendency for people to seek out and register information that confirms their worldview and ignore contradictory information, which can influence public perceptions of science (van der Linden et al., 2017). Meaningful, understandable and open scientific discussion with the public is necessary to maintain social licence than can evolve with society.

IMPROVE SCIENTIFIC TRANSPARENCY: OPEN SCIENCE TO THE PUBLIC

Science is founded on objective observation and description of the world around us and advocacy is tightly linked to subjective views and values on how that world should be. Yet, marine conservation scientists can engage in science outreach and advocacy without risking their scientific credibility or that of their scientific method (Kotcher et al., 2017). A large proportion of the public do want to know about science (Searle, 2014) and scientists could share their research through means that are more publicly accessible. Scientific communication that is fact-based, transparent and open can provide a tool for scientists to improve public understanding and appreciation of marine issues, without ever requiring persuasion.

"Proactive, persistent, clear and resonant messages are required" to promote trust in science (Gropp, 2017) and there are myriad ways that scientists can open science to the public. For example, Massive Open Online Courses (MOOCs) are free, open-enrollment web-based courses that are a resource for the public to learn about science directly from scientists. These courses provide a flexible way for the public to improve their own scientific knowledge, learning directly from experts from a wide range of scientific fields. MOOCs also facilitate scientists' ability to engage with large groups of interested public, often from the comfort of their own office.

"Skype A Scientist[1]" is another initiative that links scientists to classrooms and students across the globe. Its aim is to link students to "real scientists," to improve their understanding and appreciation of science and to interact with scientists. "Let Science Speak[2]" is a similar online platform that aims to "humanise and amplify the voices of real scientists." It provides public science information in various forms of media, including short videos, podcasts, editorials and social media, and aims to educate the public about current science and to foster support and social licence for scientists and their research.

Marine conservation scientists may also engage the services of professional science communicators, to inform themselves on best available knowledge and practise for disseminating their research, and which can save time for pursuing their important research further (Illingworth, 2017). Professional science communicators are qualified professionals who understand the need to address the context of particular marine science issues, and best means to connect theses message, to their public audiences. Whilst science is the focal message, the delivery and the messenger are also factors supporting the (un)sucessful uptake of information by any public audience. Engaging the public in science can provide a means to achieve a more ocean literate society and enhance marine citizenship, stewardship and social licence for marine conservation (McKinley et al., 2017).

DIVERSIFY PUBLIC OUTREACH: THERE ARE INFINITE WAYS TO ENGAGE AND COMMUNICATE

Public platforms that encourage exchange of opinions and concerns (i.e., participatory meetings, citizen juries, MSC Certification for fisheries, opportunities for engagement with local government) are necessary to engage society and to promote social licence for marine conservation science. Science education in schools, which involves marine scientists in outreach and teaching, can also play an important role in enhancing ocean citizenship and literacy and public support for conservation science. Targeted events, such as "science camps," considerably increase youth interest in marine science and champion science as an acceptable and viable career path (Kataržyté et al., 2017).

As highlighted above, the internet is the preferred source of public information on science, thus, it is a valuable media on which to engage and communicate with the public. The #OceanOptimism campaign is an example of active public engagement on marine conservation science issues which aims to demonstrate that not all ocean news is "doom and gloom." The movement shares positive information about successful marine conservation efforts, including an online "monthly round-up" of positive ocean news. This collaborative movement has been hugely successful in communicating science to the public and to date, the hashtag has been seen by over 74 million internet users[3].

Informal outreach can also be effective. For example, Science in the Pub is an Australia-wide initiative that brings evidence-based research to an interested public, who "weigh

[1] skypeascientist.com

[2] letsciencespeak.com

[3] oceanoptimism.org

the evidence. . .with beer." Citizen science is another rapidly expanding phenomenon that can influence research questions and provide the public with a voice in local environmental decision-making (Bonney et al., 2016). Recent developments in citizen science have bolstered projects' abilities to reach and inform wide audiences on important local, national and global issues, including marine debris, ocean plastics and climate change (Nursey-Bray et al., 2018) and actively engage the public in marine conservation science. Citizen science may be instrumental in "breaking down the barriers" between science and the public (Vann-Sander et al., 2016), improving science literacy, enhancing legitimacy of science (McKinley et al., 2017) and promoting its social licence.

CONCLUSION

The need for social licence for marine conservation, and the science that informs it, necessarily opens science to the public. Scientific impact is not only a function of economic and industrial interests and uses, but of social factors too. Marine conservation science should demonstrate itself legitimate, credible and trustworthy because positive public perceptions of science are required to ensure it is relevant and robust. Undoubtedly, the public hold some responsibility for informing themselves about science. However, we argue that scientists can engage and appeal to the public, by advocating for marine conservation science and highlighting issues and threats to the marine environment.

Given the "wicked" complexity of most marine environmental problems and conservation challenges, adequate communication and cooperative effort between researchers from diverse disciplinary backgrounds is the way forward and time is of the essence. Marine conservation science needs social licence. Marine conservation scientists can engage and gain public support for their research and the conservation of marine spaces, systems and resources.

AUTHOR CONTRIBUTIONS

RK is the primary author and this work is a component of her Ph.D. thesis. AF and GP are her two supervisors and contributed to conceiving the topic of this paper and the development of the argument and writing.

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Research

Social license through citizen science: a tool for marine conservation

Rachel Kelly [1,2,3,4], *Aysha Fleming* [3,5], *Gretta T. Pecl* [3,4], *Anett Richter* [1,2] *and Aletta Bonn* [1,2,6]

ABSTRACT. Active and meaningful public engagement is necessary to foster informed and publicly accepted natural resource management. Citizen science presents an important avenue by which to achieve such engagement. Citizen science is the active involvement of the public in science to address scientific questions, often of common interest or concern, by collecting and analyzing data, and publishing and communicating science via diverse outlets. Here, we explore whether and how citizen science can also play a role in generating social license for marine conservation, using European marine citizen science as a case study. Social license is a concept that reflects community views and expectations on the use and management of natural resources. To date, social license in the marine space has largely focused on public perceptions of industrial and extractive uses of the marine environment, and limited research has explored social license for conservation. We highlight important linkages between social license and citizen science that can work synergistically to support conservation. We use in-depth qualitative interviews and a semiquantitative online survey of marine citizen science coordinators to investigate how citizen science can play a role in enhancing social license and the mechanisms through which it can occur. Our findings indicate that citizen science can enhance social license by improving ocean literacy and marine citizenship. We demonstrate that marine citizen science has considerable potential to generate and develop social license for marine conservation in Europe and elsewhere.

Key Words: *citizen science; marine conservation; ocean literacy; social license*

INTRODUCTION

Public engagement through dialogue and participation in science is essential to improve knowledge about the environment and to support evidence-based decision making for sustainable use of ecosystems and natural resources. Transparent and culturally appropriate natural resource management is imperative (Christie et al. 2017) to foster sustainable environmental development. Society's role in decision making is increasingly recognized (e.g., Aarhus Convention [United Nations Economic Commission for Europe 1998], IPBES-6 [IPBES 2018]), and the concept of social license has become an important theme for development, particularly toward fostering stakeholder engagement and communication (Lacey et al. 2017). Understanding social acceptability of natural resource uses is crucial for environmental management (Gall and Rodwell 2016); a failure to consider whether social license exists for conservation activities can result in the failure and contestation of initiatives and management decisions (Garnett et al. 2018). However, limited knowledge exists on how to obtain and maintain social license through public engagement, which we consider includes good transparency and diversified means of communication for community dialogue (Kelly et al. 2018).

Defined most simply, social license is "an unwritten social contract" from the public for government, industry, or science to use and manage natural resources, including the marine environment (Moffat et al. 2016). Social license suggests that society (i.e., communities and stakeholders) can award or withhold permission for an activity, and the term is increasingly used to describe implicit acceptance by communities for various uses of natural resources (Hall et al. 2015, Kendal and Ford 2018*a*). Discussion around social license is growing in the media and in different bodies of academic literature, both in terrestrial and marine contexts (Boutilier 2014, Kelly et al. 2017), arguably in response to an increasingly (mis)informed society and decreasing trust in politics, government (Smits et al. 2017), and natural resource management (van Putten et al. 2018*a*).

Although not directly associated with law, the concept of social license owes its considerable power to the legal ramifications it can indirectly incur on resource users. It can be considered a precursor and decisive precondition to legal license (Garnett et al. 2018) and is a process that requires establishing meaningful partnerships among operations, communities, and governments based on mutual trust (Parsons and Moffat 2014). Social license is theorized as the ongoing acceptance or approval from stakeholder communities, and public "acceptance" is conceptualized as a minimum requirement for social license (Boutilier et al. 2012). The term social license has also been synonymized to "free, prior and informed consent" (Yates and Horvath 2013), "social acceptability" (Gall and Rodwell 2016), and "social responsibility" (Edwards and Trafford 2016). Here, we interpret "social license for marine conservation" as community acceptance or support of marine conservation activities and policies, e.g., in relation to species or habitat protection, marine resource usage, marine protected areas, etc. We interpret "improving social license" to mean increasing current public acceptance of such activities and policies.

Meaningful community engagement and dialogue is central to the development of social license (Rooney et al. 2014). Social license is dynamic, typically requiring time and effort to obtain, and can be challenged or lost as community values and perceptions change over time. As such, it is frequently easier to

[1]Helmholtz-Center for Environmental Research - UFZ, Permoserstraße 15, 04318 Leipzig, Germany, [2]German Centre for Integrative Biodiversity Research (iDiv), Deutscher Platz 5e, D-04103 Halle-Jena-Leipzig, Germany, [3]Centre for Marine Socioecology, University of Tasmania, Hobart 7001, Tasmania, [4]Institute for Marine & Antarctic Studies, Hobart, Tasmania 7001, Australia, [5]CSIRO Land and Water, Castray Esplanade, Hobart, Tasmania 7004, Australia, [6]Institue of Biodiversity, Friedrich Schiller University Jena, Dornburger Str. 159, 07743 Jena, Germany

identify where social license is not granted than where it is (Yates and Horvath 2013). Further, the impermanent and intangible nature of social license renders it difficult to measure (Hall et al. 2015), and little research to date has explored mechanisms for obtaining social license (Moffat and Zhang 2014). However, actions that have been linked to increasing likelihood of social license include meaningful dialogue with communities and demonstrated responsible behavior with regard to the use of natural resources (Yates and Horvath 2013). Furthermore, there is consensus that trust provides an essential foundation for social acceptance and social license (Prno 2013, Boutilier 2014, Moffat and Zhang 2014, Bursey and Whiting 2015, Edwards and Trafford 2016).

Because the use of the term "social license" extends across different industries, activities, and sectors, it is likely that the understanding of the concept will change and evolve (Boutilier 2014). This ambiguity associated with the concept's metaphorical roots (Cooney 2017) adds to the appeal of social license as an opportunity to improve understanding, if it can be used contextually (Prno 2013) and to serve the interests of all parties (Kelly et al. 2017). In recent years, the concept of social license has evolved for use in a conservation context, as opposed to an industry context (i.e., Voyer et al. 2015, Garnett et al. 2018, Kendal and Ford 2018*a*). In this instance, gaining social license implies achieving and maintaining public trust that resource users and managers are using natural resources and spaces ethically, in accordance with societal expectations. Communities are increasingly concerned as to how natural resources, including the marine environment, are used and developed; if such practices and uses are not perceived as socially acceptable, they are unlikely to obtain social license (Edwards and Lacey 2014). Conservation involves compromise (Dick et al. 2016), and from a conservation perspective, social license presents a flexible means to demonstrate and leverage community influence on natural resource developments and protection (Garnett et al. 2018).

It is increasingly evident that social license is important for using, developing, and protecting marine spaces (Kelly et al. 2017), but it remains unclear how social license might best be achieved through public engagement in practice. Some research has been initiated on social license for the "blue economy" (Soma and Haggett 2015), and discussion around social license for conservation is growing (i.e., Garnett et al. 2018, Kendal and Ford 2018*a*); for example, marine conservation science has been highlighted as needing to earn and develop social license (Kelly et al. 2018). To our knowledge, no empirical research has been conducted yet into social license for biodiversity conservation, or specifically, marine conservation in Europe. Here, we aim to determine whether citizen science is a novel means through which social license can be developed to improve conservation success and sustainability in the marine environment.

Citizen science is often, but not always, a partnership between members of the public and professional scientists to address scientific questions and issues of common concern (Shirk and Bonney 2015). Comparably to social license, citizen science provides a means for citizens and stakeholders to voice opinions, to engage in resource monitoring, to learn about science and scientific processes, and to evaluate and promote decision making that might otherwise exclude them (Cigliano et al. 2015). Citizen science programs are rapidly gaining acceptance as an integral part of engagement among society, science, and policy (Pecl et al. 2015, Hecker et al. 2018*a*), and although developments have been made in recent years (Hecker et al. 2018*b*), understanding of the utility of citizen science in a marine policy and management context is limited.

Community engagement has been established as essential toward achieving social license (Dare et al. 2014, Hall and Jeanneret 2014). In particular, the relationships developed through such engagement will facilitate communication and mutual understanding toward obtaining social license (Yates and Horvath 2013). The literature documents many instances of community protest against marine conservation initiatives, including marine protected areas (Voyer et al. 2015, Brennan 2018), and of noncompliance in recreational fisheries (Bergseth and Roscher 2018), and a need for more open public engagement with marine conservation has been identified (Kelly et al. 2018). We suggest that marine citizen science presents a potential platform to engage with the public more actively; to establish relationships and dialogue that can connect them with science and policy; and to increase understanding, acceptance, and support for marine conservation.

We specifically focus on the potential for marine citizen science to create a foundation for social license for marine conservation and we investigate European marine citizen science as a case study. The marine policy landscape is young and emergent within Europe, and the European Union (EU) promotes sustainable growth of maritime and coastal activities, as well as sustainable use of coastal and marine resources. However, although initiatives have been adopted to enhance the protection of the European marine environment (i.e., 2008 Marine Strategy Framework Directive, 2014 Marine Spatial Planning Directive), challenges to the effective implementation of European marine environmental management and legislation remain. A large component of these challenges include substantive criticism of "inadequate stakeholder engagement" in EU policy making (e.g., Soma and Haggett 2015). Impediments to new and planned developments include a lack of social acceptance or social license.

Linking social license to citizen science

The link between citizen science and public support for conservation and science has been advocated in the literature but has rarely been examined (Overdevest et al. 2004, Aceves-Bueno et al. 2015, Forrester et al. 2017). Ours is the first attempt to link social license theory with citizen science, aiming to investigate the potential for marine citizen science to enhance social license for marine conservation and to produce practical outcomes that can be applied to sustainable ocean management. In Table 1, we synthesise key related features of social license and citizen science from the literature and highlight common elements between the concept of social license and the practice of citizen science.

Trust is identified as a central shared component in this analysis and is also a major determinant of whether social license is granted (Boutilier 2014, Moffat and Zhang 2014). Social license is founded upon trust-based dialogue and relationships, which require maintenance and development (Yates and Horvath 2013). Trust is closely tied to processes of public engagement (Hall and Jeanneret 2014, Moffat and Zhang 2014) and takes time as parties begin to understand each other's expectations and engage in

Table 1. Synthesis of key elements common to social license and citizen science.

Social license (SL)	Key element	Citizen science (CS)
Communicating and constructing quality, two-way, meaningful dialogue with and among stakeholders is essential to generate SL (Moffat and Zhang 2014, Zhang et al. 2018)	 Engagement	Maintaining volunteer participation in CS is required to build and develop project capacity (Bonney et al. 2009, Martin et al. 2016*c*, Nursey-Bray et al. 2018)
Earning SL requires bringing stakeholders together to discuss, debate, and define issues and improve community relations (Moffat and Zhang 2014, Lacey et al. 2017)	 Connecting stakeholders	CS brings diverse users together to share information and experiences, building relationships that might otherwise not exist (Aceves-Bueno et al. 2015, Bonney et al. 2016)
Addressing SL issues by facilitating dialogue allows communities to raise concerns and opinions they might not otherwise have the opportunity to share (Edwards and Lacey 2014, Jijelava and Vanclay 2017)	 Community Representation	Collaborative development of CS between researchers and the public can identify issues and questions of community interest and enhance societal relevance of science (Thiel et al. 2014, Bonney et al. 2016)
Sharing perceptions, opinions, and experiences can enlighten stakeholders, industry, and government on the experiences of other groups (Gallois et al. 2016, Jijelava and Vanclay 2017)	 Learning & Understanding	Learning-by-doing in CS enhances understanding and scientific literacy (Bela et al. 2016, Turrini et al. 2018); participants also gain greater awareness about threats to their examined ecosystem through direct experience (Bonney et al. 2009, Crall et al. 2012)
Earning SL demands that parties demonstrate that their use of the ecosystem and data is credible, legitimate, and trustworthy (Moffat and Zhang 2014, Gall and Rodwell 2016, Jijelava and Vanclay 2017)	 Legitimacy	Citizen science promotes reflection and discussion about how science interacts with society and its values; jointly developing projects legitimizes data collection, production, and application (Aceves-Bueno et al. 2015, Göbel et al. 2016, Elliott et al. 2017)
Communicating and debating groups' interests and concerns encourage dialogue and cooperation to achieve agreement and earn SL (Gallois et al. 2016, Zhang et al. 2018)	 Cooperation & Partnerships	Working together in CS brings scientists and nonscientists together to develop and achieve joint research and educational objectives (Bonney et al. 2009, Nursey-Bray et al. 2018, Turrini et al. 2018)
Legitimizing uses of the environment increases the trustworthiness of the decision making it informs (Boutilier 2014, Jijelava and Vanclay 2017); community trust is crucial for obtaining SL (Voyer et al. 2015); trust is integral to all decision-making processes and is a central component of SL (Dare et al. 2014, Moffat and Zhang 2014)	 Trust*	Promoting public engagement and involvement in collecting evidence that informs management increases understanding and trust in these management interventions and, by extension, the people and institutions that make them (Aceves-Bueno et al. 2015, Hind-Ozan et al. 2017)
SL gives a voice to communities, that they might act as overseers of their local environments and resources (Boutilier 2014, Cullen-Knox et al. 2017)	 Stewardship	Connecting the public to the natural environment through CS can increase awareness, attachment, and willingness to protect it (Danielsen et al. 2010, Crall et al. 2012, Chen et al. 2015, Bonney et al. 2016, Newman et al. 2017)

[†]Procedural fairness is a known component for achieving social license (Moffat and Zhang 2014, Lacey et al. 2017); however, it is not a feature shared with citizen science, and thus, we do not identify it here. Further, while we recognize that trust is complex and multifaceted, the different types, forms, and components of trust are not explored separately here. We identify trust as an important component of social license and citizen science more generally.

meaningful dialogue (Edwards and Trafford 2016). Ineffective engagement and relationship building can produce distrust (Prno 2013) and resistance to future attempts to develop dialogue.

In our discussion of the outcomes of our study, we highlight trust as a predictor of social license. We explore marine citizen science coordinators' perceptions of marine citizen science and the concept of social license, as well as the potential for marine citizen science to promote trust and enhance social license for conservation. We build on the results of our survey and interviews to discuss how the two concepts influence knowledge exchange and development, and reflect on how citizen science can foster synergistic effects to improve engagement, ocean literacy, marine citizenship, trust, and ultimately, social license for marine conservation in Europe.

METHODS

We examined marine citizen science projects in Europe to investigate their potential role in promoting social license. Building on this theme, we explored linkages between the concepts of social license and citizen science. We used an adaptive theory approach in this study, akin to that of Vann-Sander et al. (2016).

In comparing and contrasting the concepts of social license and citizen science, we anticipated that new theory would be generated; it was thus necessary to ensure that all relevant information on the topic was captured effectively as it emerged through the research process.

To achieve this thorough examination, we combined in-depth qualitative interviews with an online semiquantitative survey of marine citizen science managers. We adopted this mixed-methods approach to engage as deeply and actively with participants as possible, to understand their perceptions of marine citizen science and its connection to social license occurring in practice. This mixed-methods approach ensured a complete assessment of citizen science coordinators' views on the value and potential of citizen science as a tool to enhance social license for marine conservation. Human ethics approval for this research was authorized by UFZ Datenschutz (Data Protection), Leipzig, Germany (23/06/2017).

Surveys

The initial research phase consisted of an online survey of marine citizen science project coordinators, through which we aimed to obtain information on the extent of projects in Europe and their objectives (i.e., education, data collection), as well as coordinators' perceptions of European marine management and conservation. This sample of projects was obtained from the European Marine Board's report on marine citizen science (Garcia-Soto et al. 2017) and was further supplemented by sharing the survey online among colleagues in wider networks to disseminate it to other potential respondents. Of the initial (N = 60) project coordinators approached, 34 (56.67%) coordinators responded to the online survey (conducted using Lime Survey). The survey data was analyzed in Excel (for Mac 2016). The list of survey questions is provided in Appendix 1.

Interviews

Following the survey, potential interviewees were identified from the survey respondents. All respondents were invited to partake in the interview stage, and 15 agreed to do so. These semistructured interviews were conducted by the lead author in July, August, and September 2017. The interviews lasted between 30 and 80 min, were conducted over the phone and audio recorded, and were transcribed by the lead author. To ensure the anonymity of all participant responses, interviewee names were replaced with identity codes, which were used to identify any quotations. The interview questions focused on the organization of citizen science, as well as project objectives, their development, and their potential connection to social license. Interviewees were also asked questions about their understanding and awareness of the concept of social license, both in a general sense and in a marine context. The list of interview questions is provided in Appendix 1.

All interview transcripts were subjected to thematic analytical evaluation using NVIVO 11.4.3 (QSR International, Melbourne, Australia). Initial codes were generated, and themes were developed iteratively using a grounded theory approach (Haywood 2016). Themes were reviewed, compared, and redefined when required to identify relationships between codes. Hierarchical coding was used to organize the transcripts into themes and thus produced the resulting six key themes of the study. These themes are presented below and represent the synthesized responses from the interviews, as opposed to the questions that acquired them.

ANALYSIS OF THEMES

The online survey responses represent 34 projects of varied size and purpose from more than eight European countries, the majority of which are located in the UK (19 projects or 55.8%). A full list of projects, locations, focus, and participation is provided in Appendix 2. The coordinators' responses represent a diversity of projects. The surveyed projects vary considerably in size, scope, and intent. We note that project design influences project potential to collect and share scientific information and to engage with the public (Shirk et al. 2012). Consistent with other studies on citizen science, the projects described here generally do not formally document and report on any participant learning objectives or achievements (Bela et al. 2016); hence, the interview phase assessed these elements of citizen science.

The 15 projects for which we performed interviews (Table 2) were largely representative in type and opinion of the 34 projects sampled in the online survey (Appendix 2). Both the oldest (1970s) and most recent (2017) projects were included in the interview phase. The diversity of countries of respondents to the survey were also mostly represented in the interviews. We note, however, that not all European marine countries are represented in our study and deduce that this may be a result of marine citizen science not necessarily occurring in some countries, and the English language barrier. Future European studies could focus, for instance, on the Mediterranean or Baltic Sea regions and include the diversity of languages that would be required. All project coordinators surveyed and interviewed in our study observed that marine citizen science could work to influence marine policy and management in Europe. However, we highlight that the results presented here represent the views and responses of coordinators only, and, as such, cannot be considered representative of the marine citizen science community as a whole.

The interview coding (i.e., analysis of qualitative data) produced six key themes: (1) developing understanding, (2) communicating, (3) project logistics, (4) advancing citizen science, (5) people and partnerships, and (6) connecting. Developing understanding was the most commonly identified theme (147 references across all 15 sources), and connecting was the least mentioned (with 76 references across all 15 sources). We next elucidate these six themes and refer to existing literature to identify their interplay and roles in citizen science and social license.

Developing understanding: linking social license and citizen science

This discussion theme largely focused on developing understanding of the concepts of citizen science and social license. Interviewees' responses to questions about their understanding of the concept of social license provided insight into how the term might develop under a conservation context, i.e., as called for by Kendal and Ford (2018*b*). Documenting how social license is interpreted by different parties can guide theoretical development of the concept by expanding and challenging definitions of social license and by comparing how different communities perceive and make sense of social license (Parsons and Moffat 2014). Although the term "social license" was new to all but one of the interviewees, most of the coordinators were familiar with the sense of the

Table 2. Overview of the 15 marine citizen science projects for which we obtained interviews. These projects represented six countries, had varying levels of establishment (i.e., ranging from very new to long established), had different objectives with regard to marine research and conservation, and were supported by different funding schemes.

Project name	Country	Website	Year established	Marine focus	Funding source
BeachExplorer	Germany	https://www.beachexplorer.org/	2012	Intertidal	Federal ministry
Big Seaweed Search	UK	http://www.nhm.ac.uk/seaweeds	2009	Seaweeds	Lottery funded
Capturing Our Coasts Bangor	UK (Wales)	https://www.capturingourcoast.co.uk/partner/bangor-university	2015	Intertidal	Lottery funded
Capturing Our Coasts Newcastle	UK (England)	http://www.ncl.ac.uk/nes/outreach/marine/projects/capturingourcoast/	2015	Intertidal	Lottery funded
Dive Into Science	UK	http://www.diveintoscience.org/	2008	Marine environment	None
My Ocean Sampling Day	Germany (Global)	http://www.my-osd.org/	2014	Plankton (aquatic bacteria)	Institute, federal ministry, EU
One Ocean Forum	Italy (and wider Mediterranean)	https://www.oneoceanforum.org/en/	2017	Marine environment	Rolex, Audi, other companies
Open Litter Map	Ireland	https://openlittermap.com	2017	Marine litter	Participant donations
ORCA	UK	http://www.orcaweb.org.uk	1995	Marine mammals	ORCA charity
Seasearch	UK	http://www.seasearch.org.uk/	1970s	Marine environment	National conservation bodies
Secchi Disk Study	UK	http://www.secchidisk.org/	2012	Marine environment	Secchi Disk Foundation
Spot the Jellyfish (Spot the Alienfish)	Malta (and wider Mediterranean)	http://oceania.research.um.edu.mt/jellyfish/	2010 (2017)	Jellyfish	International Ocean Institute, Malta Tourism Authority
Studland Tagging Project	UK (England)	http://www.theseahorsetrust.org/	1999	Seahorses	Sponsorship, donations
The Big Jellyfish Hunt	Ireland	https://www.facebook.com/ecojel/	2008	Jellyfish	EU INTERREG IVA (2008–2012), no funding (2013–)
Waves of Waste	UK	http://www.ywt.org.uk/waves-waste	2010	Marine litter	None

concept, albeit under different names; for example, interviewees from the UK and Ireland synonymized the term with "buy-in" and "public acceptance", and "public pressure" was another term used by interviewees.

There was strong support from all interviewees in favor of using citizen science to generate social license for marine conservation. It was widely accepted that creating social license would require specific project design and objectives. Interviewees also highlighted that, "The first step in that is people have to care and be engaged with that kind of environment, and citizen science definitely builds that sense of ownership," (interviewee C2). It was generally felt that social license actions were already happening to some degree in many places, e.g., petition for legal protection of seahorses, community resistance to coastal development plans.

Coordinators' understanding of the role of citizen science and social license largely tied into themes discussed in other studies, i.e., citizen science can enhance scientific literacy, improve ecological knowledge, promote connections with nature and locality, strengthen social ties, and influence participants' sense of stewardship and environmental responsibility (Haywood 2016, Turrini et al. 2018).

> *It comes back to the simple thing of bridging the gap and making them feel valued and having an important role in marine conservation, which is what citizen science does, it gives them that buy-in.* (Interviewee A4).

Interviewees' understanding of the term "citizen science" varied depending on the context or scope of their project. Terminology is particularly dynamic in citizen science because the field continues to develop, expand, and diversify (Eitzel et al. 2017). Most coordinators did not wish to be restricted by a definition of citizen science and were keen to extend their projects more broadly and to partner with other schemes that did not necessarily conduct citizen science. One coordinator did, however, take umbrage with the term citizen science and preferred to use the term "conservation volunteers" (interviewee B4), which the interviewee found was more accepted by the project's participants. B4 felt that the use of the word science can discourage "ordinary" members of the public, who may feel that they do not have a sufficient background in scientific research. Certainly, the meaning of citizen science can represent different things to different people and can create confusion about its nature and utility (McKinley et al. 2017). We highlight that one of the challenges of using citizen science as a means to create social license is that the objectives of citizen science need to be transparent to participants (see *Cooperation and partnerships* in Table 1). Defining these objectives with participants can be considered a project objective in itself.

Communicating: engagement and connecting stakeholders

The theme of communicating focused on the importance of engagement and data sharing in opening science to the public, particularly the different means by which marine citizen science projects interacted with their participants and how participants shared this information more widely. Engagement and sharing knowledge about the marine environment was seen as a "very strong purpose" (interviewee C2) of marine citizen science. Modes and frequency of engagement varied widely (e.g., newsletters, seminars, beach-meets, training sessions, online forums, email updates, beachside billboards) and occurred frequently (often daily) to very rarely (largely because of funding or time constraints). Consistent with other studies, coordinators highlighted the value of personal and face-to-face communication with participants in developing rapport and for engendering meaningful relationships beyond transactional interactions (Martin et al. 2016*a*).

There was strong consensus that "communication is key" (interviewee A4). Many coordinators underscored the role of the Internet in their ability to share information and to communicate efficiently with a wide public network and more easily for both participants and organizers. Social media (i.e., Facebook, Twitter) improved projects' ability to recruit participants and to remain in contact with them. For example, "The Big Jellyfish Hunt" is a project that communicates to its participants only through Facebook, and "Open Litter Map", one of the youngest projects in this study (established 2017), is also only Internet based. The importance of the Internet for these projects is not surprising. Mobile technologies facilitate much broader participation in citizen science programs that make use of developing technologies (Pimm et al. 2015). However, different marine user groups require different engagement strategies, and projects must consider their own goals and capacities when designing and implementing participant engagement (Hind-Ozan et al. 2018). Social license is founded on meaningful dialogue and communication (Yates and Horvath 2013), but exploration is required as to whether citizen science can best achieve this through face-to-face or digital media interactions.

Similarly to social license, engaging the public in citizen science and involving them in data collection that informs management can legitimize data and generate trust in its validity and application (Aceves-Bueno et al. 2015). Data sharing was an objective for several of the projects, particularly those that developed partnerships with government or academic institutions. Many projects provided data that were used in marine protected area designations and now contribute to monitoring efforts within those areas. Others such as the "Secchi Disk Study" published their data in scientific papers in open-access peer-reviewed journals (see Secchi Disk Seafarers et al. 2017). The ORCA Trust is the lead partner of the European Marine Cetacean Monitoring Coalition, a consortium of eight cetacean-monitoring organizations across Europe that are "collecting data to help inform policy and legislation, to improve the conservation of our marine space" (interviewee A4).

Sharing data was seen as a major influencing tool for marine citizen science. It was agreed that "people spreading the word" (interviewee B1) and expanding awareness of data collected or knowledge learned through marine citizen science played a big role in disseminating information to the wider public (i.e., participants' families, friends, and community networks). These observations align with other experiences in the literature, which show that volunteering in citizen science projects increases participants' concern about conservation issues, and that participants disseminate the knowledge they learn to their wider social networks (Johnson et al. 2014, Nursey-Bray et al. 2018). Successful engagement experiences may generate positive perceptions and influence the development of trust and, consequently, social license (Dare et al. 2014). Citizen science data can educate already proenvironmental participants and help them disseminate and argue the importance of marine conservation among their wider networks (Cigliano et al. 2015). Context is key when seeking to obtain and develop social license and requires identifying and understand local and community needs and interest to aid communication and to build relationships with communities and marine stakeholders (Prno 2013, Hall and Jeanneret 2014); social license has been likened to "an exercise in science communication" (Gallois et al. 2017).

Project logistics: community representation

Another theme identified in the interviews relates to practical aspects of project logistics and successfully making citizen science happen. Funding was identified by most coordinators as a primary limitation to development and engagement. The funding sources that supported projects varied greatly and included government grants, corporate sponsorships, scientific institutes, lottery funding, donations, and membership fees. Several projects had no direct source of funding whatsoever, and they struggled to expand their engagement, recruitment, and research activities. Citizen science can be a cost-effective means to gather data for scientific research (Aceves-Bueno et al. 2015), and there are numerous benefits to investing in citizen science development to enhance scientific, social, and political outcomes (Hecker et al. 2018*b*). Improving funding opportunities can enhance the likelihood of producing accurate and pertinent data for marine conservation. Overcoming funding challenges is critical to enhance the capacity of marine citizen science and its social and environmental impacts (Schläppy et al. 2017).

Other limitations included meeting participants' expectations and incorporating diverse values into development, as well as successfully retaining participants that were recruited to projects:

> *There's a lot of politics in conservation, as I'm sure you're finding out.* (Interviewee B4).

> *That is always a challenge, how do we get more people interested?* (Interviewee C5).

These limitations further emphasize the need to increase the availability of specific resources that can enhance potential partnerships and promote public engagement. Communities invoke real power and increasingly know how to use it (Boutilier 2014). Investing in marine citizen science can enhance project capacity to engage more widely with communities and address societal concerns in the research, which can legitimize the resulting data to communities and decision makers, with the aim of improving understanding and ocean literacy that can enhance social license for conservation.

Advancing citizen science: learning, understanding, and legitimacy

Developing marine citizen science projects to promote public awareness of marine issues and social acceptance of conservation was a strong subject in this theme. Although several of the projects were stagnant because of funding or other constraints, and others were only becoming established, all projects were hoping to develop and expand their scientific activities and engagement. Coordinators emphasized that marine citizen science is "not a one-size-fits-all approach" (interviewee A5), and that two-way communication between participants and coordinators is vital for developing projects that can be maintained successfully in the long term. Legitimacy and accountability are crucial components of stakeholder and community perspectives (Johansen and Nielsen 2011). In advancing marine citizen science for the value of science and policy, planners must be careful to match their programs' methods of engagement, public involvement, and participation appropriately with the type of project and focal aims (McKinley et al. 2017).

The coordinators discussed project success in improving people's understanding of marine species and ocean environments, particularly the success of marine citizen science in promoting ocean literacy: "They always learn something new; they always get excited," (interviewee A2). The majority of coordinators spoke of their very positive experiences of improved participant awareness and understanding, and how these had changed and enhanced participants' perceptions of the marine environment. However, several interviewees articulated concerns about whether citizen science project outcomes have the potential to reach all members of the public, and about the difficulties in retaining participants for longer time periods. These challenges are also felt in social license issues, where some members of the public are more engaged than others, and where the "loudest voice" might in fact not be the most representative (Cullen-Knox et al. 2017). A further difficulty is that evolving social norms and expectations will affect public acceptability and social license for marine conservation (Dare et al. 2014). An objective for future citizen science and social license research may be in determining how to ignite and sustain interest in marine science and conservation issues (Ballard et al. 2018).

People and partnerships: cooperation, partnerships, and connecting stakeholders

This theme was centered around engaging participants and partnerships from across society. Partnership building with other groups and organizations was seen a means for projects to "strengthen the research data, the quality of the data we were getting, and the engagement and messaging we were doing" (interviewee C2). Citizen science can bring experts and nonexperts together in partnerships that foster shared positive action to cocreate knowledge and build understanding (Dickinson et al. 2012, Jordan et al. 2012) that can enhance social license. Although levels of involvement and influence varied, benefits that projects sought and gained through partnerships included the ability to recruit more participants, more scope to engage with the public, enhanced ability to share data they collected, and larger pools of funding to expand project activities. In the UK, in particular, many projects were affiliated with government agencies, which reflects their policy relevance (Owen and Parker 2018). Coordinators believed that the larger their project network, the larger the impact their projects activities could have.

> *The larger the diversity with citizen science, I think that the higher are the chances it has an impact on social license.* (Interviewee C4).

Participant types varied across and within projects, recruiting from "every single walk of life, from dustbin men to scientists to all those in between" (interviewee B4). This observation is consistent with a growing body of literature that recognizes citizen science participants as diverse and representative of many kinds of people (Thiel et al. 2014, Cigliano et al. 2015). It is also a positive indicator of the potential of citizen science to engage a range of social subgroups, which is necessary to develop social license for conservation. This observation reflects the value of marine citizen science for engaging with a large body of the European public, building understanding and enhancing ocean literacy, to enhance social license for marine conservation efforts. Projects that recruit from populations with more diverse groups of age, attitude, and education are more likely to engage participants with varied views on conservation (Forrester et al. 2017).

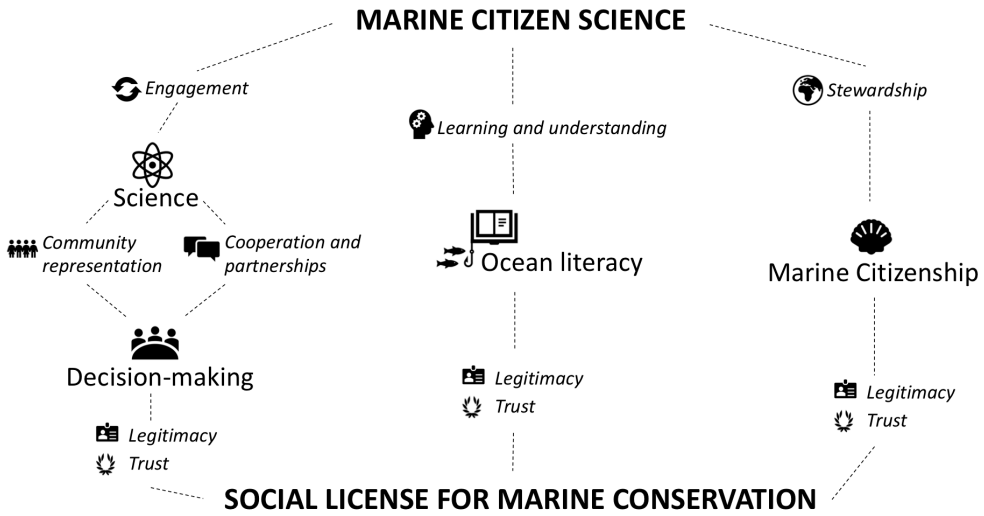
We note, however, that other research suggests that a large proportion of marine citizen science participants are more highly educated than the general public (Martin et al. 2016*c*). Participants are also self-selected and are likely to already hold positive views toward science and conservation before they engage in citizen science (Bonney et al. 2016, Martin et al. 2016*b*). This area is certainly pertinent for exploration that would guide development of recruitment and engagement for citizen science in Europe and elsewhere. It is important to consider who participates in these projects when developing marine citizen science to enhance ocean literacy and improve social license. When developed appropriately, the participatory structure of citizen science can promote the inclusion of diverse perspectives in decision-making processes (McKinley et al. 2017) and can increase the legitimacy and social license of decisions made in marine management.

Connecting: trust, marine citizenship, and stewardship

Creating ownership through citizen science and improving marine citizenship were seen as key outcomes of connecting participants to the marine environment. The interviewees largely agreed that marine citizen science is a valuable means to raise awareness and provide opportunities for the public to learn by doing and to connect them to marine environments they would not normally be aware of or have exposure to. Participation in marine citizen science was considered a pivotal step for generating ocean literacy and reducing the "disconnect between people and nature" (interviewee C5) to legitimize conservation and improve its social license. However, there was consensus that developing marine citizen science for this purpose would require adequate planning to address these objectives. The coordinator opinions reflect those in the literature about the need to understand the potential of citizen science as a communication and engagement tool (Groulx et al. 2017).

The process of earning social license is similar to that of citizen science because it brings members of the public together to discuss and address issues of common concern. Citizen science is undoubtedly valuable in fostering environmental stewardship (McKinley et al. 2017) because participants most frequently have strong positive attitudes toward the environment, demonstrate proenvironmental behavior, and believe that their actions

Fig. 1. Marine citizen science legitimizes science to the public and enhances ocean literacy and marine citizenship to enhance social license for marine conservation.



contribute to the value of natural resource conservation (Merenlender et al. 2016). Stewardship also plays a role in social license because it gives communities a voice to oversee usage and development of their local environments and can instill public responsibility for natural resources (Table 1) and develop marine citizenship (Fig. 1). Projects in our study demonstrated that "citizen science gives [participants] a closer relationship with their local environment, or whatever environment they're sampling from... [and] ultimately gives people a greater understanding of the natural world and the environment in general" (interviewee B5). Feelings of connectedness and ownership are known to increase participants' trust in the citizen science to which they are contributing (Dickinson et al. 2012). These feelings of trust are also a major determinant of whether participants will award social license (Boutilier 2014).

Marine citizen science was seen to legitimize marine conservation by connecting people to their local and marine environments and generating a sense of place through ownership of that space.

> *It's more likely that people protect what they know and what they value.* (Interviewee A3).
>
> *It gives ownership of an area to stakeholders who normally feel disconnected.* (Interviewee B3).
>
> *I think that is very, very powerful, when you get the locals themselves caring about the marine environment.* (Interviewee B1).

This observation is in agreement with results of other studies that show that people frequently need to experience the ocean (and its problems) personally before they are likely to change their views and attitudes (Steel et al. 2005). Leveraging this "power of place" is posited as a valuable means to improve conservation decision making and increase participation in citizen science (Newman et al. 2017). We identify this sense of place component as one that requires future exploration and development in the marine context (van Putten et al. 2018*b*), especially for enhancing marine citizenship. Marine citizenship, i.e., an individual's rights and responsibilities regarding the marine environment, necessitates increased awareness about marine issues, adequate understanding about the personal role and behavior involved in creating and solving these issues, and a positive shift in values that can promote ocean-friendly, proenvironmental behavioral decisions (McKinley and Fletcher 2012).

Ownership, developing ocean literacy, and marine stewardship were seen as requirements for generating understanding and personal connection to the ocean and trust in decision makers managing marine spaces. Trust was an important topic strongly linked to communication because participants who continue to be engaged effectively will continue to trust citizen science projects and their outcomes (Hind-Ozan et al. 2018). This can legitimize research and the data collected and increase the trustworthiness and social license of the marine management decisions they inform. The project coordinators largely agree that developing trust for marine conservation in Europe is a complex challenge that will need to be met with complex, complementary approaches because often, "people trust what they want to hear" (interviewee C4). Participants' interaction with scientists was seen as a way to legitimize data and decisions, again through personal contact and developing understanding of the processes and entities involved.

DISCUSSION

Sustainable natural resource management, including marine conservation, requires that management and policies are socially accepted. Public involvement in natural resource issues and decision making increasingly is expected. Community ability to influence political decision making, particularly through

lobbying activities, has set a precedent for the development of social license in natural resource management (Cullen-Knox et al. 2017), and promoting a need for social license highlights the importance of community perspectives in conservation (Kendal and Ford 2018*a*). Citizen science is one means of public engagement that can strongly improve social license for marine conservation.

The results of our study are in agreement with other studies that have shown that citizen science can engage and inform the public about science and the natural environment and enhance empowerment to act (Martin et al. 2016*a,* McKinley et al. 2017, Nursey-Bray et al. 2018). Public engagement achieved through citizen science, via joint data collection and collaborative research, can innovate research and societal processes at the science-policy interface (Hecker et al. 2018*b*). This public engagement also provides an avenue to develop social acceptance, allowing communities and society to partake in and influence policy development and decisions that will affect them (Soma and Haggett 2015). Establishing this dialogue with and among marine stakeholders is imperative to achieve the more meaningful relationships underpinning social license for conservation (Moffat and Zhang 2014).

Our interview analysis finds that there is strong support in favor of using citizen science as a platform to develop social license for marine conservation. However, these results represent the views and responses of citizen science coordinators only and are not representative of the wider marine citizen science community. Citizen science programs provide opportunity for open discourse that is accessible to the public (McKinley et al. 2017), and our study demonstrates that citizen science can play a role in enhancing social license for marine conservation (Fig. 1) in Europe by: (1) legitimizing science, i.e., opening science to the public and creating a joint evidence base for decisionmaking; (2) improving ocean literacy, i.e., building participants' understanding about marine issues; and (3) promoting marine citizenship by connecting participants to the ocean.

We have determined that trust is a strong linkage between the concepts of social license and citizen science. Legitimizing research and use of the marine environment through citizen science increases the trustworthiness and social license of the marine management decisions it informs (Boutilier 2014, Jijelava and Vanclay 2017). Marine citizen science can legitimize marine conservation by connecting people to marine environments and enhancing their understanding of marine issues. Citizen science involves the public in data collection and decision making that gives legitimacy to management decisions by increasing transparency (Reed 2008). Building upon legitimacy and community trust can help to create social license (Boutilier et al. 2012). However, there is no easy way to establish social license (Prno 2013); it is a dynamic and ongoing process of community engagement actively seeking to maintain trust (Zhang et al. 2018).

Citizen science may also be an effective means to promote scientific literacy among the public (Bonney et al. 2009), and our study has demonstrated its value in promoting ocean literacy. Citizen science promotes reflection and discussion on how science interacts with society and societal values and how we can embed these more deeply into public thinking and decision making (Storksdieck et al. 2016). Citizen science can foster broader societal impacts, especially in promoting conservation awareness because "personal conversation is probably the biggest spreader of education" (interviewee B4). Engagement achieved through citizen science can enhance flows and exchanges of information among communities, scientists, marine managers, and policy decision makers to help produce solutions that promote better environmental and social outcomes and therefore can help to mitigate conflict in natural resource management (McKinley et al. 2017).

There is widespread agreement on the need and importance of incorporating stakeholder groups and the public into marine conservation management through meaningful participation and engagement (Voyer et al. 2012, Brown et al. 2016). Citizen science is ideally placed for this engagement and can act as a catalyst for individual behavioral change that is linked to environmental stewardship of marine systems (Cigliano et al. 2015). In a similar way to which social license provides a voice for communities (Boutilier 2014, Cullen-Knox et al. 2017), participation in citizen science can instill volunteers with a sense of ownership, of both the data they collect (Reed 2008) and the areas that they monitor (Newman et al. 2017). Fostering these connections and developing feelings of ownership can enhance marine citizenship and increase public support and social license for marine conservation.

We have identified how marine citizen science may influence knowledge and opinions, connect diverse users of the marine environment, and improve ocean literacy to improve social license for marine conservation in Europe and, potentially, elsewhere. We synthesized linkages between the concepts of social license and citizen science (Table 1) that we hope can guide the development of further research on the role of citizen science in enhancing social license. Another direction for future research could be to explore dissimilarities between the concepts of social license and citizen science, and in what instances the concepts perhaps might not work to enhance one another.

As we have described, social license and citizen science are complex processes that both emerge from positive, potentially diverse, public engagement. For instance, social media has been identified as an emerging tool with which to earn and improve social license (Yates and Horvath 2013). The transferability of our results to other disciplines is another avenue of research that could be pursued. There would also be value in obtaining participant views of citizen science, social license, and marine conservation to complement our study because citizen science volunteers can represent a diverse range of people with various backgrounds and incentives to participate (Thiel et al. 2014). Recognizing diversity and heterogeneity in the public's connection to the sea is critical for addressing public needs appropriately in marine conservation engagement efforts (Jefferson et al. 2015).

The concept of social license is useful because it recognizes the importance and power of communities (Morrison 2014). In considering the need for social license, organizations such as government agencies can design agendas and actions that attempt to obtain public support and approval (Jijelava and Vanclay 2017). We suggest that marine management and decision-making authorities consider marine citizen science as a tool to engage the public and work toward achieving support and social license for their activities.

CONCLUSION

Obtaining social license for conservation requires engagement with communities that promotes dialogue and cooperation (Zhang et al. 2018). Citizen science can be a means to foster this cooperation by providing opportunities for individuals to participate in coordinated research efforts (Shirk et al. 2012). We have demonstrated clear linkages between citizen science and social license that are useful for exploration and application not only in a marine context, but also in terrestrial space. We have highlighted how the concepts of social license and citizen science influence knowledge exchange and development in drawing from sources in the literature and discussing our results.

We have identified how citizen science can foster synergistic effects to improve engagement, ocean literacy, trust, and, ultimately, social license for marine conservation (Fig. 1). Participants in marine citizen science have the opportunity to learn and experience how science is conducted and how it contributes to conservation, decision making, and management, and this experience can be a powerful, transformative, and legitimizing experience (McKinley et al. 2017). We propose that marine citizen science is strategically placed to promote trust and enhance social license for marine conservation. Marine citizen science can serve as a valuable platform to connect the public to ocean environments, but it should not be assumed that participants will automatically support ocean protection or conservation management. Generating social license through marine citizen science requires developing meaningful relationships with participants and earning their trust through engagement, education, sharing of information, dialogue, and transparency. Achieving such objectives in Europe requires planning resources, staff, and expertise, to which many European marine citizen science projects do not have access.

Our research supports growing policy calls that highlight the development of marine citizen science as an imperative objective to achieve engagement, ocean literacy, and marine citizenship. To achieve these aims and to enhance social license for conservation, more opportunities for citizen science, including funding, will need to be made available. The costs of policy implementation associated with a lack of social license can escalate rapidly across community, governmental, market, and environmental expenditures. European marine conservation requires public awareness, understanding, and social license, and marine citizen science is a purposeful means by which to achieve these aspects.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/issues/responses.php/10704

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Citizen science and social licence: Improving perceptions and connecting marine user groups

Rachel Kelly[a,b,*], Aysha Fleming[b,c], Gretta T. Pecl[a,b]

[a] Institute for Marine & Antarctic Studies, Hobart, Tasmania, 7001, Australia
[b] Centre for Marine Socioecology, University of Tasmania, Hobart, Tasmania, 7005, Australia
[c] CSIRO Land and Water, Castray Esplanade Hobart, Tasmania, 7001, Australia

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ABSTRACT

Marine stakeholder groups have diverse relationships with the ocean and life within it, which can create conflict and distrust between them. Citizen science and social licence present promising means to develop dialogue between these diverse marine stakeholders and improve outcomes for marine management. Citizen science can be defined as public engagement in scientific research and activities and amongst other benefits, has been demonstrated to improve communication and relationships amongst resource management and stakeholder groups. Social licence is a concept that reflects unwritten permission from the public for others to use and manage natural resources, and has become an important theme for development in the marine realm. We explore a case-study of the marine citizen science programme Redmap Australia, utilising a mixed-methods approach to understand community perceptions of other marine user groups. We explore how marine users legitimise one another, and how this relates to building relationships and developing social licence. Our results show that participation in citizen science can allow users to display their marine citizenship and shared concern about the marine environment, and that this can allow them to earn trust from other user groups. We conclude that participation in citizen science improves perceptions of trustworthiness and can enhance social licence for marine user groups, with positive implications for marine and coastal management. These outcomes provide fruitful insights on marine resource user groups' perceptions that can help to advise future developments in the growing fields of citizen science practice and citizen science research.

1. Introduction

Ocean and coastal environments are intrinsically diverse and dynamic, complicated by varying scales and the multiplicity of stakeholders who use and enjoy them. These marine stakeholder groups have diverse relationships with the ocean and life within it, and incorporating their many social, economic and cultural values can create significant conflict and resistance in marine use and management. Such conflict can create distrust between stakeholder groups (Lester et al., 2017), making relationships between diverse groups a key point of tension in the marine environment (Boucquey et al., 2016). Engaging with stakeholder groups requires recognition of their complex and diverse perceptions, attitudes and objectives, and social science approaches offer opportunities to engage with a broad marine stakeholder base (Spalding and Biedenweg, 2017). Resolving conflict in the marine environment is often context-specific (Christie et al., 2017), but exploring 'people-to-people relationships' can advise mediators and marine managers towards achieving best outcomes and social licence (i.e. community acceptance or approval) for ocean and coastal management and for the stakeholder groups who share and use marine spaces and resources (Jones et al., 2016).

This paper builds on an expanding field of research which explores approaches and opportunities to achieve positive outcomes for science and society through citizen science (i.e. a partnership between the public and scientists to address questions and issues of common concern) (Danielsen et al., 2010; Kelly et al., 2019). We provide insight into diverse processes occurring within citizen science and explore how the concept of social licence might be developed or facilitated through the citizen science experience. Previous studies have demonstrated that citizen science plays a valuable role in facilitating community engagement with natural resources and environmental issues (Nursey-Bray et al., 2018). Here, we use a case-study of the Australian marine citizen science programme Redmap (Range Extension Database and Mapping Programme) to investigate how citizen science may meaningfully

* Corresponding author. Institute for Marine & Antarctic Studies, Hobart, Tasmania, 7001, Australia.
E-mail address: r.kelly@utas.edu.au (R. Kelly).

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include social uses and interests of diverse resource user groups, and whether it can promote exchange between these groups to improve perceptions and bolster social licence (i.e. social acceptance and support) for their activities in the marine environment. We investigate the potential for marine citizen science to be used as a tool to enhance engagement between, and social licence for, diverse marine user groups, i.e. whether social licence can be improved through participation in citizen science.

Social licence is not a formal or literal (paper) licence. However, it frequently co-occurs with formal legal requirements that explicitly require community input and consultation and thus, it is representative of community values and perceptions. It is a dynamic concept, 'an unwritten social contract' (Moffat et al., 2015) that signifies ongoing acceptance or approval from the community (Parsons and Moffat, 2014), who are usually local residents or resource stakeholders, to access or use natural resources, i.e. the marine environment. It generally requires time and effort to achieve, and can be lost as community perceptions change and evolve over time (Yates and Horvath, 2013). The concept of social licence has no legal standing, but this does not lessen its influence and the significant community power it invokes (Murphy-Gregory, 2018).

More often than not, it is easier to identify where social licence is not granted than where it is (Yates and Horvath, 2013). The intangible and impermanent nature of social licence renders it difficult to measure or monitor (Hall et al., 2014); however, good indicators include reduction (or absence) of vocal opposition to activities, continuing constructive conversation with communities, and willingness of communities and stakeholders to enter into dialogue and form partnerships. Interactions, conversation and meaningful engagement are integral to its developmental process (Rooney et al., 2014). Social licence can span local, regional and national scales (Dare et al., 2014), and it is likely to operate differently depending on context (Hall et al., 2014). We anticipate that much can be gained by exploring how social licence is potentially attained and/or developed through citizen science in the marine realm.

In the terrestrial literature, social licence has been depicted in various frameworks. These include the Pyramid Model (Thomson and Boutilier, 2011) and the Three Strand Model (Morrison, 2014). The origins of these two frameworks differ, but both interpretations rely on legitimacy that is based upon stakeholders' judgement of others' visible properties, behaviours and/or passive judgement based on cues from other stakeholders (Gehman et al., 2017). The Pyramid Model is founded upon legitimacy, but its apex is trust, which (Thomson and Boutilier, 2011) consider to indicate that an activity has low socio-political risk. In contrast, the Three Strand Model relates social licence to other forms of licences, but it also highlights the importance of trust in creating social licence. Morrison (2014) determines that trust is a component 'based on reciprocity', which is created and sustained by actively maintaining relationships with communities. Engaging with communities and stakeholder groups is critical for building trust and plays a unique role in achieving social licence at multiple scales (Dare et al., 2014).

Earning social licence requires bringing groups together to discuss and debate concerns and to improve community relations (Moffat and Zhang, 2014; Lacey et al., 2017). However, to date, limited research has been conducted into the processes involved in obtaining social licence and the factors attributed to maintaining it (Moffat and Zhang, 2014). Suggested actions towards generating social licence include timely and effective communication, meaningful dialogue, and ethical and responsible behaviour with regards to the use of natural (including marine) resources (Yates and Horvath, 2013). Working with others facilitates knowledge exchange and allows parties to learn about one another. This learning is essential, in terms of social licence, to inform and promote legitimacy of other groups (Boutilier and Thomson, 2015).

Citizen science can provide a platform for diverse groups to address issues and questions of common interest (Thiel et al., 2014; Bonney et al., 2016; Kelly et al., 2019). In a similar way to which social licence is founded on legitimacy, trust and the shared values that resource users and managers must operate by (Boutilier and Thomson, 2015), citizen science 'comes alive' through networking and exchange between science and society (Bonn et al., 2016). The negotiation of social licence is inherently cooperative and a component of this is developing understanding by each group about other groups' perceptions and attitudes to issues of common concern (Gallois et al., 2016); i.e. the marine environment. We posit that citizen science is ideally placed to facilitate this, because it potentially connects groups to share experiences and to foster relationships that might otherwise not have opportunity to exist (Aceves-Bueno et al., 2015; Bonney et al., 2016). For example Kelly et al. (2019), identify several key attributes which link the concepts of social licence and citizen science, including 'representation' and 'connecting stakeholders'. Participation in citizen science, or other types of community-based monitoring, is one way that a group may potentially demonstrate responsible stewardship of a resource or demonstrate their role (and legitimacy) in contributing knowledge and information about a resource (Merenlender et al., 2016).

Public participation in scientific research and activities is not a novel concept (Bonney et al., 2009). Citizen science is an established means of engaging the public to collect and disseminate data for science (Bonn et al., 2016). It is distinguished as a valuable form of research because it expands scales of data and engagement (Newman et al., 2015) and facilitates more meaningful public interaction with science, as well as the application of new knowledge and data. The social licence literature describes how sharing perceptions, views and experiences can enlighten stakeholders on the experiences of other groups (Gallois et al., 2016; Jijelava and Vanclay, 2017) and learning-by-doing is a characteristic of citizen science that we suggest can facilitate this exchange. Further, partnerships achieved through citizen science may create pathways for support between social groups and promote networks for collaborative decision making that can enhance outcomes for science and management (Danielsen et al., 2010).

The aim of this case study is to explore the relationship between citizen science and marine social licence, in the context of marine stakeholder interactions. Both citizen science and social licence present promising means to develop dialogue between stakeholders involved in, affected by, or interested in resource use and development (Moffat et al., 2015). Citizen science projects have been demonstrated to improve communication and relationships amongst resource management and stakeholder groups (Shirk et al., 2012), but to date, large gaps remain in our understanding of the utility of citizen science in a marine policy or social licence context. We explore how marine users interact with and legitimise one another, and how this relates to building relationships, to provide insight into how the concept of social licence (i.e. for marine user groups) might be developed or facilitated through the citizen science experience. Building upon current knowledge of the processes involved in creating social licence (i.e. not necessarily the outcomes), we explore whether marine user groups' participation in citizen science may provide opportunity to enhance (theirs and others') social licence.

2. Methods

In this study, we examined marine user groups perceptions of one another to investigate whether citizen science might play a role in informing and/or improving those perceptions and enhancing social licence. To increase our chances of obtaining views and perceptions from a broad range of marine user groups, we chose to combine two methods. We adopted this mixed-methods approach to obtain a more comprehensive understanding of our research enquiry than could be provided using either quantitative or qualitative approaches alone (Creswell and Plano Clark, 2011). We implemented an online semi-quantitative survey of Redmap participants and built upon this by later conducting in-depth, semi-structured qualitative interviews. Human

ethics approval for this research was authorised by the University of Tasmania, Australia in April 2017 (HREC ref: H0016442).

2.1. Redmap

Redmap is a website-based data-collection project, hosted across Australia, that calls on marine users to submit photographs and locational information on marine species that they have observed outside their expected geographical ranges. Marine scientists verify this information before it is added to the growing database of potential 'species on the move'. We selected Redmap as a model case-study for several reasons. First, as a marine citizen science programme it garners strong public interest because of the strong connections and close proximity of most Australians to coastal and marine environments (Nursey-Bray et al., 2018). Second, Redmap has defined scientific and social programme objectives. Third, Redmap is a web-based portal available at www.redmap.org.au and has a smartphone app, increasing its potential public outreach. The two primary aims of Redmap are:

1. To collate out-of-range species observations that can provide early indications of species that might be shifting geographically, possibly in response to changing environmental conditions such as warming waters associated with climate change (Pecl et al., 2019);
2. To educate and engage the community on issues around marine species range shifts and climate change. Redmap has been demonstrated to be a successful 'social learning tool' (Nursey-Bray et al., 2018).

We note that participation in citizen science is often self-selected, and participants are likely to already hold positive views towards science and (or) conservation before they commence their involvement (Bonney et al., 2016; Martin et al., 2016). However, citizen science volunteers in general can represent a diverse range of people with various demographic backgrounds and incentives to participate (Thiel et al., 2014). Redmap is an opportunistic (i.e. contributory) citizen science programme and no training is required to participate. These characteristics of the Redmap programme might reduce barriers to participation and the self-selection that is observed in other programmes. Regardless, we address any potential bias in our study sample by also including coastal community members from New South Wales, Australia (recreational fishers and divers and other marine users) who were *not* involved with the programme, as well as Redmap participants.

2.2. Questionnaire surveys

The first phase of this study consisted of a questionnaire survey of the national Redmap community, using the online survey platform SurveyMonkey. It was promoted through Redmap social media and remained open for three weeks during April and May 2017. The objective of the survey was to collect demographic information on Redmap participants, their activities in the marine environment, and their views on marine sustainability, and to recruit participants for the qualitative interviews. Participants from different demographics can be expected to have different perceptions and values in regards to the marine environment (e.g. women might express more concern on marine issues) (Eleiton et al., 2015), and in the case of this study, incorporating a more diverse demographic would infer that more perceptions are included.

The questionnaire survey included a mix of multiple-choice and open-answer questions, and these questions sought to identify the relative number of user groups (e.g., recreational fishers, divers, etc.) participating in Redmap and to obtain demographic information about the Redmap community, their geographic spread, and their participation in other local activities (see Appendix A). The consortium of Redmap participants have typically been considered as three distinct groups: fishers, divers, or boaters (Nursey-Bray et al., 2018). Some citizen science research suggests that participants typically come from factions of society, i.e. highly educated (see e.g., Martin, 2017), whilst other research contests that citizen science participants are representative of a wide range of demographic backgrounds (Thiel et al., 2014). These questions aimed to identify whether any demographic effects were apparent in our sample of participants. Other questions sought to identify majority user groups and explore participants' perceptions of the Redmap programme; e.g., why they participate and whether this has enhanced their interest in marine sustainability in Australia. Questions about perceptions of the Redmap programme sought to understand whether participants thought that other Redmap participants shared their values of the marine environment and marine sustainability and whether they believed these values were distinct from that of the wider population.

2.3. Interviews

Following the online survey phase, several interviewees were identified (i.e. they volunteered) from the questionnaire survey respondents, whilst the others were identified via snowball sampling; i.e. initial informants (marine educators, marine community leaders, etc.) were identified and the subsequent interview sample was built by asking for recommendations from these people (Young et al., 2018). The interviewees were sampled from local communities in the townships of Eden, Merimbula and Port Stephens, all in the state of New South Wales, Australia. The sample included interviewees from i) the Redmap participant community, and ii) members of the broader marine community who did not participate in the Redmap programme. A total of thirty-three semi-structured interviews were conducted by the lead author in November 2017, mostly in person (n = 26). However, Redmap participants who had volunteered through the online questionnaire survey and were located elsewhere were interviewed over the phone (n = 7). The sample size used in this study is typical of qualitative case-study research. We follow the precedent set by other studies, where participant samples of approximately thirty are generally considered suitable (Marshall et al., 2013; Saunders and Townsend, 2016).

Interview methods can provide insight on stakeholders' knowledge, values and beliefs (Young et al., 2018), and the interviews described here aimed to capture the views and perceptions of Redmap participants, as well as other coastal community members who did not participate in Redmap. The interview questions were semi-structured, i.e. standard questions were asked in each interview to allow comparison, but the interviewer could also probe with other questions if an interesting or relevant line of enquiry developed during the interview conversation (Young et al., 2018). This format allowed for some differentiation between the questions asked to Redmap and non-Redmap interviewees. The Redmap participant interviewees were probed with questions that explored their perceptions of the Redmap programme and its role as a platform to connect user groups because, as discussed above, facilitating and promoting community engagement is a necessary precondition to developing social licence (Yates and Horvath, 2013). In contrast, the community members were interviewed to explore whether their perceptions differed from Redmap participants and whether they had interest in the concept of the Redmap programme and might participate in the future. They were asked whether and how they currently interact with other marine users, what influenced their opinions, and whether they would like to participate in citizen science in the future.

Other questions that were similar for both groups queried interviewees' understanding on the concept of social licence, to identify differences and similarities in knowledge and understanding, and to determine whether interviewees perceived Redmap as a mean to promote engagement and dialogue that could facilitate the development of social licence. The ambiguity associated with social licence may represent opportunity in its development and expansion towards stakeholder engagement (Fleming and Howden, 2016). The questions

around social licence were designed to understand how marine users interpret and perceive social licence, to potentially guide theoretical development and discourse (Parsons and Moffat, 2014). Documenting how social licence is understood by communities is beneficial for identifying criteria and conditions for achieving and assessing it, and for comparing how different groups or communities enact and 'make sense' of social licence (Parsons and Moffat, 2014). A full list of survey and interview questions is provided in Appendix A.

The interviews lasted between 10 and 40 minutes, and were audio-recorded and transcribed professionally before being analysed by the lead author. To protect the confidentiality of all participants, all participant names were replaced with identity codes (as used for quotations below). All interview transcripts were analysed using NVIVO 11 qualitative data analysis software (QSR International). Initial codes were generated, then themes were developed iteratively using a grounded theory approach (Haywood, 2015). This allowed for the interview findings (i.e. themes) to emerge from the data without restrictions imposed by more structured approaches (Hay, 2010). These were reviewed, compared and redefined to capture where relationships between codes were identified. The final themes were obtained and organised through hierarchical coding.

The resulting key themes identified below represent the aggregated interview responses, as opposed to the questions that guided them. These thematic results focus on topics discussed in the interviews, including social licence, perceptions, conflict and aspects of the Redmap programme. Qualitative interviews can provide insight into 'the meanings that individuals and groups attach to experiences, social processes, practices and events, for example, by policy decision makers' (Edwards and Holland, 2013), and here, interviewee quotations are used to elucidate and describe the themes that emerged from our analysis. The interviewee quotations used below are intended to be descriptive, and not representative, of marine user group perceptions.

3. Results and thematic discussion

3.1. Questionnaire survey

In total, we received 142 responses from the open survey call (56% male; 44% female). The questionnaire survey respondents could identify themselves as more than one 'type' of marine user. They self-identified primarily as divers (57%), fishers (51%) or naturalists (51%). Other user types identified included boaters, surfers, snorkelers, beachgoers and conservationists. This result confirms that of other research, determining that Redmap involves many different marine user groups, and some who might not typically engage in citizen science (Pecl et al., 2019). This is interesting to note because diverse stakeholder involvement in citizen science projects can enable broader and more effective uptake of the data collected, improving knowledge exchange around environmental issues (Göbel et al., 2016) and increases the likelihood that citizen science can support an open and informed society (Craglia and Shanley, 2015). This is important for guiding future development of citizen science, and also for identifying stakeholder groups when working to develop social licence.

Participants engaged with Redmap largely out of personal interest, i.e.

> *'I enjoy the ocean so much and am interested in what is moving into our area'* (RX11);
>
> *'Interested in impact of climate change on marine life'* (RX33).

Eagerness to contribute to scientific impacts and learning were also motivations to participate in the programme, participants were enthusiastic and engaged with the Redmap programme:

> *'It is useful to know what is happening in our local waters and to know which species have been found in Australian and Tasmanian waters don't belong there. To help understand what the warming waters is doing to our marine life'* (RX4);
>
> *'I value our oceans and want to support the scientific community'* (RX14);
>
> *'It's good to keep people informed and see what is being found'* (RX2);
>
> *'I gain a lot of insight from the information. I also understand the movement of species which I can identify in my local marine environment and appreciate how amazing they are'* (RX20).

91% of respondents said that they found Redmap social media to be educational and more than 75% stated that they had recommended the Redmap programme to someone else, including friends, family and club members and through social media posts online, which confirms previous research on the Redmap programme Nursey-Bray et al. (2018) identified that 78% of participants had recommended Redmap to someone else. In fact, 62% confirmed they had shared information which they had learned through Redmap social media to other people. Redmap respondents had a strong view that they were a group who were more strongly concerned with marine sustainability issues than the general public (91%) and 55% indicated that their engagement with the Redmap programme had further increased their interest in marine sustainability. Further, Redmap participants' consensus view that they are a group distinct from the larger public has interesting connotations for dialogue and engagement around social licence, because participation in Redmap infers a sense of legitimacy to other participants, regardless of their activity within the marine environment.

Open-answer survey responses to questions about marine sustainability showed that Redmap participants (63%) felt that most Australians are concerned about sustainability but that the public are largely ignorant as to the extent of problems in the marine environment:

> *'Marine sustainability is not high enough in general awareness. I think people see beautiful beaches and think, 'everything's fine''* (SX5).

Despite this, responses showed that Redmap participants were optimistic about public concern for marine sustainability and highlighted that education would be the primary route towards improving public understanding and support:

> *'They're concerned, but not necessarily in ways that are realistic. More, ongoing, community education is essential'* (SX44);
>
> *'Increased education is vital'* (SX17);
>
> *'I think people are crying out for information about marine resources that is written in plain English'* (SX83).

3.2. Interviews

There were more male interview participants than for the surveys; twenty-one (63.6%) men and twelve women (36.4%). Distinct from the online questionnaire survey phase, the interviewees represented Redmap participants and non-Redmap participants. Of these interviewees, 36.4% identified that they had participated in the Redmap programme. Thus, the representation of marine user groups differed; 27% identified as divers, 45% as fishers and 33% as other, again which included boaters, surfers and snorkelers. No observable contrast between the opinions of Redmap and non-Redmap participants was recorded, variability of opinions occurred across the entire group of interviewees. The majority of non-Redmap participants stated that they would be interested to participate in the programme in the future. Redmap participants noted that their observation of other marine user groups participating in Redmap improved their perceptions of these groups (e.g. divers' perception of fishers):

> *'[Redmap participants] at least have an understanding with the species and are more switched on. And a bit more caring about the environment'*

(KS_13N);

'I'm actually heartened a bit to see them there because I tend to lump everyone in the same category and I know that's wrong … It's nice to see that fishermen are participating' (KW_13N).

Social licence issues that interviewees had observed personally included opposition to marine parks, strong community acceptance of recreational fisheries, and community resistance to aquaculture development and fishing trawlers. The survey respondents and interviewees shared consensus that education and interaction through citizen science would be a primary means to improve public understanding and social licence for marine user groups. Hierarchical coding analysis of the interview transcripts identified four general themes which were discussed by the stakeholders: *marine groups' perceptions of one another, marine user conflict, views and potential of the Redmap programme, and social licence for marine user groups. Marine groups' perceptions of one another* was the most commonly identified theme, with 96 references, whilst *marine user conflict* was the least discussed, with 22 references in the interviews. These four themes were structured from the accumulated interview responses, as opposed to the questions that acquired them, and are explored and interpreted more deeply below, where we elucidate the survey and interview results, using key quotations from the data transcripts, and their context to the relationship between citizen science and social licence.

3.3. Marine groups' perceptions of one another

In consensus with previous studies on Redmap, divers and fishers constituted the primary users of Redmap and also the primary marine users represented in the interview analysis. However, interviewees' overwhelmingly perceived recreational fishermen as the most dominant marine user group. This might be because New South Wales is a hub for recreational fishing in Australia (West et al., 2015) or that recreational fishing is a much more visible activity on the water than diving, because diving activity in New South Wales is also recorded at very high numbers (AustralianSportsCommission, 2010). Further, these two user groups had very distinct opinions about one another. Fishers were regarded as a dominant group and environmental attitudes of recreational fishers were perceived to be:

'*Changing, compared to what it was, say 20 years ago. A lot more are aware of the environment itself*' (GT_14N).

Whilst many did regard fishers '*just like any other group*' (PW_13N), others thought that *'they kind of run their own show'* (KK_5D). By and large, however, interviewees recognised that it is a small percentage of the recreational fishing who inform the poor perceptions of the general public:

'There's always a small population that gives the rest of us a bad name' (BL_20N);

'It's that one percentage' (BL_14N).

The general view of divers was that they were a 'green' user group, *'more sort-of conservation focused'* (AB_20N), who *'keep to themselves a bit'* (GT_14N). The segregation of user groups was clear, and distinct cultures were identified that maintained each group's own identity. Interestingly, several of the survey respondents and interviewees identified themselves as both fisher and diver, demonstrating that these groups are not in fact as separate as they might appear to be; i.e. there may be overlap between recreational fishers, and recreational and extractive (shellfish or lobster) diver groups. Largely, interviewees were open to the idea of interacting with other marine groups, if the opportunity arose, but that '*would have to happen off water*' (AB_20N). Misinformation was seen as the biggest barrier towards creating trust between groups and *'becoming more aware'* (DW_13N) was a common sentiment as to how bridges between these groups might be developed:

'A small minority may ruin it for those people but I think the main thing is, understanding what that group needs or what all the other groups need and being able to work with them on that' (TW_22N).

Redmap is ideally positioned for such interaction because participants can interact on its online platforms (e.g. website, Facebook, Twitter, etc.) and can discuss issues away from the marine environments which they so often contentiously share.

3.4. Marine user conflict

Interviewees' opinions about conflict varied across experiences, however they largely agreed that conflict was something unavoidable:

'There's always going to be conflict' (DH_4D);

'That's the thing in the community, everyone's got a different opinion on how it should be' (JM_14N).

The most distinct conflict observed amongst interviewees was that between (non-extractive) scuba divers and recreational fishers:

'Fishers don't like the divers and the divers don't like the fishers' (DH_4D).

If community groups can better understand each other, they may support more considered, developed and balanced opinions and perceptions of other groups, and their values which can promote fruitful discussion and positive outcomes for marine management. Social influencers were identified as a means to promote credibility, legitimacy and trust for marine groups, all prerequisite steps to earning social licence (Boutilier, 2014):

'*You would need some influential popular people on that group to bring about social licence, definitely'* (KW_13N).

Citizen science provides opportunity for open dialogue which a broader community of users can access, comprehend and trust (McKinley et al., 2017). In the case of Redmap, it also removes participants from potential physical sites of conflict:

'If they've got issues with other user groups you've removed that usual confrontation area, which is, "I'm in my spot, you're coming into my spot" type thing. Whereas when you're sitting behind a keyboard at home or on your phone, you don't have that' (TW_22N).

Interviewees thought that programmes like Redmap are a platform to '*get the different user groups talking*' (MH_7D) and to connect and legitimise them based on their common interest of the marine environment.

3.5. Views and potential of the redmap programme

In this study, participants recognised the unusual nature of Redmap's broad engagement, appealing to *'different sectors that often are in conflict'* (AJ_21N) and value in providing *'factual information that people can access'* (NG_7D). Redmap engagement was seen in a positive light by interviewees who were familiar with the programme; this is consistent with previous assessments in which participants identified Redmap as a forum through which they can access new information (Nursey-Bray et al., 2018). Citizen science has been shown to foster environmental stewardship, prompting participants to care more about their environment (Ballard et al., 2018) and increase intention to engage in pro-environmental activities (Crall et al., 2012). For instance, engaging with citizen science programs can facilitate more positive perceptions of resource management and of user groups, and in this study, participation in Redmap was perceived positively by the participants, as a demonstration of responsible stewardship:

'*They would be more likely if they're into conservation'* (JB_15N).

One way to foster stakeholder connections through citizen science is

to tap into existent networks within projects' communities to recruit new participants (Haywood, 2015), e.g., fishing, diving clubs, tackle shops, etc. Citizen science participants are known to share the information they learn through citizen science and many intend to adopt new behaviours as a result of the learning they experience through these programmes (Dean et al., 2018; Nursey-Bray et al., 2018). This may be further bolstered by identifying social influencers or champions who are trustworthy sources of information within the community, who can share information that is trusted and can improve community understanding and acceptance of other marine user groups. Redmap has already engaged volunteers to act as champions, and this engagement has been shown to meet the needs and interests of marine users who are keen to share information about citizen science (Martin et al., 2016). Further, Redmap involves many different marine user groups, some of whom might not typically engage in citizen science (Pecl et al., 2019).

3.6. Social licence for marine user groups

'Finding some common ground' (TN_20N) was seen as a primary requirement for connecting and engaging stakeholders in developing social licence because it requires being perceived as legitimate (Boutilier, 2014). Both facts- and values-based drivers play a role in determining whether social licence in give or withheld (Cullen-Knox et al., 2017). Interviewees were very much of the opinion that:

'You've got to prove that you are trustworthy, a sustainable user of the environment, and that you're willing to work with those other user groups' (TW_22N);

' … engage with key stakeholders to provide them with information that they probably didn't know about' (CB_21N).

Further thoughts around social licence focused on what the term meant for participants, whether they had observed it in action in their local areas, and how social licence for marine user groups (e.g., recreational fishers) might best be achieved. There was a strong sense that social licence action was necessary and already happening, across a range of community issues. Interviewees identified social licence as:

'Social acceptance for the thing you're doing' (CY_15N);

'That big green tick [public acceptance] is something that people want' (RC_20N).

The concept of social licence is a continuous process to be sustained through repeated interaction and positive engagement with other marine users and stakeholders, and marine user interactions facilitated through participation in citizen science foster and encourage new social bonds (Haywood, 2015):

'People value people. And I think people would give out their social licence certainly more when they are informed and involved in that' (AB_20N).

Whether diverse perceptions of marine users are based on truth or not, research demonstrates the participation in citizen science can connect people with each other and with natural environments through emotional and reflective experiences that can empower them (Cigliano et al., 2015; Haywood, 2015; Groulx et al., 2017). Citizen science provides opportunity for interaction between potentially like-minded members of different user group communities (Dickinson et al., 2012):

'I think that Redmap and facilitating that kind of conversation between fishers and other users is a really good way to generate social licence.' (AB_20N).

Creating social licence requires knowledge and meaning-making (Rooney et al., 2014) and citizen science can facilitate this for marine users by promoting interaction with other user groups. Participation in Redmap improved perceptions of trustworthiness amongst marine user groups and supports the inference that participation in citizen science can create shared understanding that engenders social licence for diverse user groups, including recreational fishers:

'Getting different user groups talking to each other, I think is really helpful' (MH_7D);

'Redmap is the kind of thing that would bring them together' (JM_20N).

Interviewees did acknowledge the difficulty in engaging the broad community of marine users and that having a platform, such as Redmap, *'is going to be critical'* (AJ_21N). Engaging with diverse marine user groups requires different communication techniques and strategies (Hind-Ozan et al., 2017). In citizen science, challenges exist for all stakeholders, which require designing, promoting and supporting programmes that incorporate the wider community in their activities (Martin, 2017).

3.7. Future directions and limitations

There are certainly potential overlaps between the concepts of social licence and citizen science (Kelly et al., 2019) and the results of our study demonstrate linkages that are observed through Redmap. We note, however, that the design of Redmap promotes inclusion of different marine user groups from the broader community who might not otherwise be formally engaged or willing to be involved in citizen science (Pecl et al., 2019). We have investigated a specific case-study of Redmap Australia, and thus, there may be several limitations in applying this knowledge to the wider citizen science community, including:

- Cultural – we engaged with marine stakeholders, who might have different views and/or perceptions to citizen science participants and community members of more inland regions.
- Temporal - at the time the surveys and interviews were undertaken, no major conflicts existed in the marine communities we engaged with (that we are aware of). Thus, the interviewees might have been more open to engage with other groups at this time, than when a major conflict had been rife.

Still, the outcomes of our study provide fruitful insights on perceptions and views of trustworthiness between marine resource user groups, that can help to advise future developments in the growing fields of citizen science practice and citizen science research. The findings of this study are directly relevant to how social licence might be facilitated in other contexts and highlight citizen science as both a novel and useful tool to explore further in developing social licence in the context of marine management. Future research that could enhance progress in this space includes identifying why people participate in citizen science programmes such as Redmap, whether there are other marine stakeholder groups that might not be engaged through citizen science, and whether there may be other participatory approaches to engaging with communities and enhancing social licence, apart from citizen science. Exploring who constitute the participants of citizen science (Martin et al., 2016), how these participant groups interact and how they engage and communicate around the process of social licence, may also generate knowledge that can better inform human dimensions of ocean conservation (Kelly et al., 2017). Better understanding of the views and perceptions of key stakeholders engaging in citizen science can help to explain the dynamics of citizen science (Vann-Sander et al., 2016) and its potential influence on marine space social licence and ocean and coastal management.

Programmes such as Redmap have high potential to act as a mechanism that instigates behavioural change towards, for example, the fishing sector, environmental issues and/or stewardship because they work beyond supplying factual information and actively engage community members about environmental issues (Dean et al., 2018). Citizen science programmes are ideally positioned to connect diverse

participants and groups together by focusing on a common problem or goal, and this can foster new knowledge and improve networks of communication between stakeholders (McGreavy et al., 2016). Marine stakeholders are a complex and diverse mix of people and engaging with them will require recognition of their diverse values, perceptions, attitudes and objectives. This study has identified citizen science as a tool to improve marine user groups' perceptions of one another and to gain legitimacy, trust and social licence for their activities, which can improve deliberation and outcomes for marine management.

Our study proposes that marine user groups' participation in citizen science can improve how they are perceived by other groups and enhance their legitimacy, which fosters social licence (i.e. social acceptance and support) for their activities in the marine environment. Marine citizen science is established as a means to engage the public in marine research which can contribute valuable knowledge to science and society (Martin et al., 2016). Previous studies have determined that citizen science is a platform on which community members can contribute to solutions for better environmental management outcomes and collaborate to avoid unnecessary conflict (McKinley et al., 2017). Marine user groups' participation in citizen science also provides an opportunity for them to improve and display their marine citizenship (McKinley and Fletcher, 2012) and to portray themselves more positively in the views of other users.

5. Conclusion

The concept of social licence has many components (Parsons and Moffat, 2014) and in this study, we focused on trust, legitimacy and relationships. We identified the potential for citizen science to be involved in creating and building social licence, but not necessarily the outcomes of achieving it or maintaining it. The results of this case-study demonstrate that marine citizen science

i. provides opportunity for marine users to connect with one another,
ii. can improve their understanding of other user groups, and
iii. can reveal their shared values of the marine environment,

towards improving different user groups' perceptions and acceptance of one another's activities. We have shown that participation in programmes such as Redmap can improve perceptions of trustworthiness amongst marine user groups.

Social licence has popular appeal because it conveys the notion of community acceptance and support (Bursey and Whiting, 2015). However, it is important to recognise that social licence does not equate to one group dominating over another. Achieving social licence can demand a flexible approach that is responsive to diverse interests from a range of stakeholders (Yates and Horvath, 2013). There is certainly benefit to be gained (and earned) by all parties if built collaboratively through mutual sharing, dialogue, understanding, learning and collaboration and the results of this study suggest that citizen science can provide such a flexible and inclusive approach. As the results of this study have shown, engagement with marine stakeholders is based on complex and diverse perceptions, attitudes and objectives, and interaction between marine user groups can be improved through their participation in marine citizen science, with potential applications for marine management. This study is important because we included the perceptions of citizen science participants as well as the broader marine community. However, we did not examine the relationships and engagements that actually occurred in Redmap, and this is an area of research where further exploration is required.

The results of this study show that marine user groups considered citizen science as a means to improve public understanding and social licence for their activities. The themes presented in this paper can be built upon in developing marine citizen science programmes that can engage diverse user groups and interest. In particular, developing social licence through citizen science may have positive implications for marine management by providing 'common ground' on which to create some shared understanding and engender social licence for diverse user groups. This exploration of citizen science as a tool to connect and engage diverse stakeholder groups can direct future research, to guide the development of new citizen science programmes and objectives.

Social licence is a dynamic concept and in this instance, is a continuous process of repeated interaction and positive engagement with marine users and stakeholders. Interdisciplinary cooperation between the natural sciences, who conceive and implement citizen science programmes, and social sciences, who have greater capacity to evaluate these programme outcomes, will be key in the advancement of citizen science and in its potential for engagement and development of social licence in the marine realm.

Conflict of interest

GP is the Chair of the Redmap Australia Steering Committee. The other authors declare no conflict of interest.

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Appendix A. Survey Questions

Demographics

1. Male/female
2. Age
3. Education a. Year 10
   b. Year 12
   c. Certificate Dip/Ed
   d. Bachelor Degree
   e. Advanced degree (e.g. Masters, PhD)
4. Highest level of education in science?
   a. Studied science after high school
   b. Elective/specific high school science subjects
   c. Compulsory/general high school subjects
   d. Only studied science at primary school
   e. Never studied science
5. Location (by state)
6. Do you identify yourself as: 'fisher'/'diver'/'boater'/'other'? *Option to select primary, then multiple responses.*
7. For each:
   a. How long have you been, e.g. a fisher?
   b. Where? *Locally/nationally/internationally?*
   c. Are you a member of a club in your region? *How many?*

Social Capital/Networks

8. How long have you lived in the area you live now?
   a. Lifelong
   b. 20 + years
   c. 5–20 years
   d. 1–5 years
   e. Less than one year
9. Do you fish/dive/boat in your local area?
10. Do you participate in other local activities clubs? *If yes, identify.*
11. How active do you consider yourself involve in local community activities?
    a. Extremely
    b. Very
    c. Somewhat
    d. Occasionally

e. Not at all active
12. Do any of your family members participate in local activities or clubs?

Redmap

13. How did you hear about Redmap?
    a. Friend
    b. Family member
    c. Local club
    d. Online
    e. Other
14. Are you a follower of Redmap Facebook, Twitter, newsletter, etc.? *(Tick boxes)*
15. How long have you followed Redmap on social media, etc.?
16. Have you ever logged a sighting on the Redmap website? *If yes, how many times?*
17. Have you ever recommended Redmap to someone else?
    a. Friend
    b. Family member
    c. Club member
    d. Online post
18. Do you find Redmap social media educational? *Fishing/CC/ocean/other*
    a. If yes, What? Have you shared this knowledge with others?
19. Does your involvement in Redmap increase your interaction with other groups, i.e. fishers? *Yes/no, identify*

Final section

20. How well do you think Australia manages its marine resources (i.e. marine environment, fisheries, etc.) sustainably? *Extremely well/Very well/Okay/Badly/Very badly*
21. In your opinion, do you think Australians are concerned with marine sustainability?
22. Has engagement with Redmap increased your interest in marine sustainability?
23. In your opinion, are people who engage with Redmap generally concerned with marine sustainability?
24. Comments

Interview Questions

Opening hello

Identification

1. Do you consider yourself a fisher, diver or boater (or multiple of these)?
    a. How often do you fish, dive, etc.?
    b. Alone, with friends, in a club?
2. In your experience, who are the main marine space users in Australia?

*Redmap (for Redmap participants only) **

3. What are your opinions of Redmap as a participatory citizen science programme?
4. Are you currently involved or do you participate in (interact with) Redmap? *If yes, how?*
    a. Ba*sed on your own experiences who do you think the main user groups of Redmap are?*
    b. Do they communicate? How?
    c. Are the groups within Redmap distinct? Why?
    d. Do you feel that there a majority user group in Redmap? Who?
5. In your experience, is Redmap a platform on which you can communicate with different ocean user groups (i.e. recreational fishers)?
    a. Online, in person?
    b. Has it changed your opinion of these other groups (i.e. recreational fishers)?
6. Does Redmap social media influence your opinions about other marine user groups (recreational fishers)?
    a. How? Which groups?
    b. In your opinion, does Redmap promote all marine user groups equally?
7. How would you envisage Redmap being used to promote communication and exchange between different user groups?

Social licence

8. Have you heard about SLO? **Define it here – ongoing approval or broad social acceptance … '*
    a. Where?
    b. In what context?
    c. What does 'SLO' mean to you?
9. Do you think SLO actually occurs?
    a. Where?
    b. For which groups? For management? Local, regional, national?
10. Do you think that SLO is influential in decisions made about marine space use or regulation?
11. Do you think Redmap (as a participatory citizen science programme) can influence SLO? (Explain question)
    a. In what ways? Through what processes? (Who?)
    b. In which industries/spaces?
12. Has your participation in Redmap changed your perspective of other groups (i.e. SLO to recreational fishing)?

Closing thank you

**For non-Redmap interviewees*

13. Do you interact with other users of the marine space (divers, boaters, fishers, etc.)? *If yes, how?*
14. Based on your own experiences, do you think the different user groups interact?
    e. Do they communicate? How?
    f. Do you feel that there a majority marine user group? Who?
15. Would you like to have opportunities to communicate with different ocean user groups (i.e. recreational fishers)?
16. What influences your opinions about other marine user groups (recreational fishers)? *i.e. social media, local media, community networks, personal experiences?*
    a. How? Which groups?
17. Would you like to increase communication and exchange between different user groups? *i.e. citizen science, local meet-ups, social events, etc. How?*
18. Have you heard about the programme Redmap (citizen science)? *Are you interested in participating?* (useful to differentiate)

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